

**Operability in Systems Concept and
Design:
Survey, Assessment, and Implementation
Final Report**

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INTRODUCTION

For decades space system development has often been viewed as a series of experiments; each extending the performance capabilities of the nation's ability to exploit the unique environment of space. Whether it was increased payload capacity, higher resolution, greater bandwidth, or the exploration of the unknown, the focus was principally on either increasing the performance of a current capability or the developing of a new capability. Often driven by national security objectives, cost and support considerations were frequently sacrificed. Even though the development process was guided by some of the nation's brightest engineers, scientists and managers their primary focus was ensuring that these systems were able to meet their performance objectives in a reliable manner and not on providing support for an extended life-cycle.

In those robust times there generally was a lack of focus on the systems life-cycle beyond meeting the pure performance objectives and the initial operation of the system. The focus on performance and a view of the development as a "one-of-a-kind" process, often caused other key facets of the system development process to be ignored in comparison to other system performance measures. Although recognized as key development objectives in other complex systems, the areas such as producibility, maintainability, supportability and life-cycle cost were often overshadowed despite the fact that these parameters affected the majority of the cost of owning and operating the systems.

As the value and demand of operations in space increased, the desire for extended capability, greater dependability, increased resiliency, and new levels of integration and interoperability among space systems have also increased. Yet the growing dependence on space systems has not been met with parallel increases in development budgets. Much like other areas of the economy, the spending on space systems has faced downsizing, demanding both government agencies and the commercial sector to do more for less. In key areas of the exploitation of space, principally space launch and commercial imagery, the United States market share has seen similar downsizing.

This study documents an assessment of the tools that are being used by the government and the commercial sector to meet the challenge of addressing the reliability, maintainability and supportability of new systems in the hope that the application of these tools will lead to a reversal in this decreasing market share through lower cost and easier to operate space systems. Also addressed is the definition of "**operability**" and the tools that are being used to improve the operability of systems currently in development.

OBJECTIVES

The National Aeronautics and Space Administration has pioneered many areas of applied research and system development. Many of these system development efforts filled, or attempted to fill, very high expectations and the fact that the systems simply completed their mission with an adequate degree of safety was a landmark achievement. The system either accomplished the mission or not; the question of optimizing the overall "ability to operate" may have seemed a bit too much to ask. Furthermore, such systems were rarely, if ever, used again, so Reliability (R) got considerable attention, but Maintainability (M) and Supportability (S) slipped by almost unnoticed. And yet, NASA is now placing greater emphasis on re-using equipment in hopes of lowering costs, placing

greater emphasis on Maintainability and Supportability, and asking the question: "What is system Operability? And, How does one plan to get it?"

New mission requirements and new budget levels keep these questions current, and engender an awareness that obtaining some answers to these questions is important. The sooner the designer can evaluate RM&S and Operability in the development process, the more likely he will achieve desirable levels of those attributes. The evaluation may be more difficult in the early phases. Thus, the evaluation must be late enough to have some degree of accuracy and yet early enough to have some degree of influence. This is not a new dilemma. Designers and manufacturers of more "every day" products have faced it and some have devised methods and tools which substantively contribute to the evaluation process.

The purpose of this study was to assist NASA in the assessment of these evaluation tools and determine which of them, if any, could contribute in the early phases of this system development process.

ASSESS THE STATE-OF-THE-ART IN RM&S/OPERABILITY

The first objective of this study was to assess the state-of-the-art in RM&S/Operability(R&M's/O). Accomplishing this objective involved a survey and assessment of the tools that are in use by key organizations in industry, academia and the government. Specifically this consisted of designing and distributing a questionnaire to the organizations identified as data sources, requesting a relatively swift response, placing those responses in a database, and using the team's experience and knowledge to assess the applicability of each of the responses to the pre-concept exploration tasks of space system design. The details of this survey process and an assessment of the results are provided in the following sections.

Design of Questionnaire

The team drafted a questionnaire that would guide the research efforts. This questionnaire contains the basic elements of information to adequately characterize the candidates to be considered and was structured to incorporate certain screening criteria to facilitate the inventorying process. The questionnaire included the following subject areas:

Name of Tool-A brief text entry giving the name and acronym (if any) of the tool.

Scope and Intent of Tool-A brief text input describing what the tool is supposed to do.

Availability for NASA Usage-An affirmative or negative as to whether NASA can have this tool.

Potential Space System Applicability-A brief text entry of envisioned space system usage of the tool.

Life-Cycle Phase Applicability -The appropriate acquisition or life cycle phases in which the tool is useful; that is, Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operation, Modification, or Disposal.

Computer-An entry describing the computer type and the operating system required for the tool.

Resource Requirements -Two numerical entries showing the amount of memory and the amount of mass storage required (in kilobytes) to execute and store the modeling tool.

Portability-An entry showing how easy it is to re-host the tool from one machine to another.

Training-An entry describing the background, training and time required to become an effective user.

Money-The cost of acquiring the tool and cost of user support, if available.

License-The privileges associated with the above cost: one machine, site license, upgrades, etc.

Time-The number of days required to deliver and install the tool.

Validation and Verification-A description of the validation or verification method and results, if any.

In addition to the survey, the criterion by which the answers would be judged was also defined. Of the 12 criterion listed above (the tool name is not a criterion), Scope and Intent of Tool and Availability for NASA Usage are de-selectors; that is, if the tool is not for RM&S/Operability evaluation, or if the tool cannot be acquired by NASA, they are not viable candidates, even though the questionnaire information may still be useful to provoke ideas. Potential Space System Applicability is only moderately weighted because the submitting company may not see any space system applications but the team and NASA may recognize some usage they did not consider. Life-Cycle Phase Applicability is relatively important because the initial version of the toolbox will be targeted for the Concept Exploration phase. Computer, Resource Requirements, Training and Portability will be heavily weighted because it is important to construct a toolbox that is (1) easy to install and de-install on machines commonly available within NASA and, (2) has a clearly understood graphical user interface. It may be necessary to develop this during toolbox construction but the more of these qualities that the constituent tools already have the less development will be required. Validation and Verification is only moderately weighted because, although important, it is rarely done with analytical tools and thus may be more of a distinguishing attribute than a qualifying attribute. Finally, Money, License, and Time become relatively important because of the budgetary and schedule constraints of the using community.

Data Collection Methodology

Before selecting specific individuals to solicit responses to the questionnaire, a general survey was made of the types of firms and positions that would (1) be most likely to develop and/or use RM&S/O tools and, (2) provide a representative cross-section of organizations that would use such tools. Accordingly, a search via Internet and at the Redstone Scientific Information Center(RSIC) were made. On the basis of these searches some 67 organizations were identified as possible contacts. From this list, a detailed search was made to identify incumbents with the result being that 33% were identified. Next, the list of organizations was reviewed to select those believed representative of the industry/government sector. This included general machinery, automotive, process industries and engineering design firms and systems houses, plus those firms/organizations in the aerospace field. In addition, a few Universities and technical societies were added although it was believed that these organizations would not be likely to respond or to have such tools. Finally, names and organizations were added where there was reason to believe that those individuals/organizations were users/developers of RM&S/O tools. These actions brought the survey population up to a total of 87.

The positions represented were typically those of Chief Engineer, Technical Director, or Vice President - Engineering. At this time no direct contacts were made with any of the identified individuals/organizations other than to eliminate what appeared to be duplicates within a given firm (e.g., Ford Motor Company appeared in four places early on). It should also be noted that an extensive search was made both on the Internet and at RSIC using systems operability and variations as the search keywords. Very little was found indicating that this is an area that is either very emergent or is so included in other terms that it is not readily identified by conventional search strategies.

At this point the list of 87 names/organizations was provided, in either hard copy or PC compatible media format, a copy of the survey package. After time had elapsed sufficiently for responses to be made, calls were made to selected organizations and of these, about a third of the group were available for discussions. The remainder had moved on, did not return the calls, or were unavailable (on travel, etc.). The calls determined that there was about an even split between responses of the type "I saw the questionnaire and haven't done anything with it.", "I never saw it.", or "I haven't had time to look at it." While it was never explicitly stated, the unsaid part of the contacts seemed to indicate that most individuals contacted were not overly interested in the mechanics of completing the questionnaire, regardless of the apparent importance of the survey. In most cases the individual contacted wanted a follow-up copy of the questionnaire. A few offered the response that their respective employer's policy was not to respond to this type of survey. The initial mailing was made in October 1995 with a follow-up in early December 1995.

The list of names and organizations is provided as an appendix to this report.

Database Design

The database was implemented in FileMaker Pro version 3.0 and was organized around the contacts that submitted survey responses. Contact name, address, telephone number, and answers on operability definition and summary questions were grouped into one database. A second database was constructed that mimics the questionnaire and contains the information that describes the submitted tool. These two databases are linked by defining a contact and tool identification field.

The application itself was designed for ease of use on a desktop or a networked server. Printed reports are discouraged because of the amount of information contained within the database.

FileMaker Pro version 3.0 was selected because of its ability to run on both Macintosh and PC platforms, operate in a networked environment and ease of use as a relational database.

The database has restricted access offering a limited amount of protection from inadvertent corruption and disclosure to unauthorized individuals. Note that some of the information contained in the database has not been approved for public release and therefore will have to be carefully screened before being provided to others in either printed copies or over a network.

A help file built into the application contains more information on the proper use of the databases.

Analysis of Responses

Of the participants surveyed there were 78 tools submitted from 38 different contacts. Twenty two (22) of these respondents were from industry and the other 16 were from government. The majority of the government responses came from elements within the US Army; US Army Missile Command or Space And Strategic Defense Command.

The 78 tools covered a wide variety of subjects related to the RM&S area. The most prominent area was reliability. Other areas covered were availability, maintainability, supportability, cost, design guidelines and ergonomics.

Lessons Learned

In advertising, there's a rule of thumb that you have to put something before a consumer a minimum of three times before he will take notice. This appears to hold true for surveys as well. However, the response rate was considerably above the norm for such mailings. This is attributed to two factors. First, the chosen population was screened in advance and consisted of individuals/organizations that were believed to be involved in tool development and application and therefore much more likely to respond to this type of survey. Second, calls were made to a sizable proportion of the survey population after the initial mailing and then to the response to that mailing. Notwithstanding all this, the responses that were received were satisfactory, which to some degree was surprising since the state of operability as a design parameter appears to be at this time ill-defined in general. One factor that appeared in conversations during the calls is that a number of firms view the requested information as being competitive in nature. The aerospace community was generally open in the sense that knowledge/tools used by both the Government and industry tend to be freely shared. This is enhanced by the relatively free movement of technical personnel between government and industry and within the industry itself.

In retrospect, while the sample population was believed to be representative of the provider/user community, a larger sample -- say double that used -- would probably not yield much different results, but would have provided increased confidence in obtained results. Thus, the first recommendation would be to expand the survey population if it becomes necessary to repeat the survey. Secondly, time should be allowed for a minimum of three mailings of questionnaires. While most persons contacted indicated an interest in the survey, there was a prevailing attitude of disinterest in survey questionnaires. One way to counter this is to utilize additional mailings in combination with telephone follow-up(s). While time-consuming, the use of telemarketing survey techniques might well be considered for future surveys as personal contact seemed to increase interest on the part of those contacted.

Analysis of Operability Definitions

In the questionnaire one of the more subjective requests was to provide the best definition available for the term "**operability**". Despite its subjectivity, this was an extremely important topic and speaks to the core issue of this effort. It is difficult to evaluate the operability of a system or a system design if one does not know what "operability" is. We wanted to obtain a number of responses to see if a consensus was

developing and to either select the most useful definition or to be guided in the development of a useful definition. If the definition is indeed useful, the presence of a consensus is a secondary matter.

The responses displayed considerable diversity and no strong consensus was apparent. Many of the responses tended to fall into one or more of the following four categories:

- "Operability" was defined to be a synonym for systems engineering; that is, the term included Reliability, Maintainability, Supportability, Flexibility, Safety, Cost, and even political considerations (which would enlarge the scope of systems engineering). Unfortunately, definitions of such breadth undermine their own usefulness because they are difficult to quantify and they are competing with a number of other terms used to describe "the whole world".
- "Operability" was confused with other "ilities", such as Reliability. This is not very useful either because these other "ilities" usually have their own definitions and advocates which do not need to be shared with "Operability".
- "Operability" was often connected with ergonomics which might not be a totally bad thing to do for systems which are operated by human beings. A connection, however, is not a definition.
- "Operability" was defined in terms of descriptions of specific system design solutions. For example, one definition of "operability" was the ability to meet a specified flight schedule. This confines the definition to flying systems. Such definitions may later be useful as examples.

The four categories of attempted definitions helped us to determine some properties we would like to see in a good definition. These properties are:

- The definition must be specific enough to be scaleable (e.g., quantified or ranked).
- The definition must be general enough to apply to any system.
- The definition must not be identical or almost identical to some other well-established "ility".

We found only a single definition of "operability" in a textbook entitled Software Engineering. It was a rather good approach at a definition. "Operability" was defined as "usability plus efficiency of resources". Of course, it may be argued that "usability" violates one of the properties listed above. The text's approach included a matrix of system development characteristics which built up into "usability" for a software item. Our intent would be to employ this for guidance in arriving at a definition of operability applicable to hardware, software, and systems in general. Also, "usability" as such is not a well developed discipline, and so if operability and usability are in fact nearly synonymous, no harm will be done.

A Recommended RM&S/O Paradigm

Our definition of "operability" contributes to part of a total system paradigm based on the life cycle of the system. Almost any system has these major stages in its life cycle: design (which includes the acquisition phases from Pre-Concept through Full Scale development), production (which includes manufacture and test), operation and support, and disposal. During the design stage the developer determines most of the system properties which will determine the "goodness" of the system in the other stages. The other stages therefore, call for the primary "ilities" which should be considered during design. These primary "ilities" are:

Producibility - the ability to produce the system. This relates to the ease of manufacture and involves the standardization of tools and materials, design tolerances, factory layout, and other "design for quality" considerations. Producibility helps to determine Acquisition Cost.

Operability - the ability to operate the system while it is performing its intended function; that is, during its "up time". This relates to the ease of operation of the system from the user standpoint as well as many of its traditional "Measures Of Performance". Operability determines Operating Cost.

Supportability - the ability to support the system while it is preparing for another functional period; that is, during its "down time". This relates to the ease of maintaining the system and includes:

- Reliability** - the frequency of maintenance
- Maintainability** - the duration of maintenance
- Logistic Resources** - the materials and cost of maintenance.

Supportability determines Support Costs which embraces the cost of training, technical publications, spares, support equipment and some facilities.

Disposability - the ability to dispose of the system when it can no longer perform its function well enough to continue operating. This relates to hazardous wastes, salvage of components, and disposal locations. Disposability determines Disposal Cost, or, if negative, Salvage Value. This study only deals with the first three of the four primary "ilities" but disposability is growing in importance and should be considered at the outset of the design process.

This paradigm runs contrary to the notion many people have about operability. It argues for a definition of operability which does not include many aspects of Reliability and Maintainability. Operability characterizes the goodness of a system while it is "up" and performing its intended mission. Thus, the definition of operability we offer is as follows:

"Operability is the ease with which a system operator can perform the assigned mission with a system when that system is functioning as designed."

Can "ease" be scaled? Can the operator ease of mission accomplishment for one system be said to be more or less than that of another system? We believe that it can. This certainly includes some human factor considerations but it does not include them all (the human factor consideration for maintenance would fall under Maintainability and thus Supportability). It would also include many performance characteristics of the system whether those characteristics are fuel consumption, clock speed, computational accuracy, or electrical power requirements.

Let us consider a simple example of this paradigm in action. Suppose we need to develop a system for cutting trees on a small scale and we are developing the system with its entire life cycle in consideration. For now, let us subjectively rank our four "ilities" on a scale from 1 (poor) to 10 (excellent) and add up our score with an equal weighting so that 40 would be an ideal system.

Three design teams have come up with three different approaches to achieve the required mission. Design Team #1 has proposed a double-bladed axe, Design Team #2 has proposed a cross-cut saw, and Design Team #3 has proposed a chain saw. Obviously, the first two teams are going to win the Producibility contest. All they have to do is to name the materials and geometry's, establish a sturdy means of affixing a comfortable handle, and set up the lathes and grinders to start production. The cross - cut saw is somewhat more difficult to produce because of the complex shape of the blade requiring skillful machining and perhaps more expensive metals to withstand the stress on small thin structures. Let us give the axe a Producibility score of 9 and the cross-cut saw a score of 8. The chain saw, on the other hand, is much more difficult. It involves castings, moldings, pumps and filters, fuel, lubrication, and ignition. Let us give it a Producibility score of 5.

Operability is a different story. The operators range from teenage girls to men in their seventies, and include athletes as well as convalescents. To cut down a hardwood tree two feet in diameter takes an hour of strenuous effort with the axe, forty minutes with the cross-cut (twenty five if two people are sawing) and about ten minutes with the chain saw. The chain saw is marginally more dangerous but not if used properly. Fuel and lubricant are inexpensive and consumed efficiently. The axe weighs seven pounds, the cross-cut eight, and the chain saw eleven. Let us give the axe an Operability score of 4, the cross cut a score of 5, and the chain saw a score of 9.

The Supportability scores would be much closer. All the implements are fairly reliable. The major failure modes for the axe are a loose handle, a broken handle, and a notched or dull blade. The cross-cut suffers from loose handles, a dull blade and a broken blade. The chain saw is subject to a dull chain, clogging in the fuel system, improper lubrication, failed or dirty spark plug and a broken ignition cord or spring. Except for the loose handles, all of these require a trip to the local hardware store where the needed skills, tools and parts are in abundant supply. The axe and the cross-cut both receive a Supportability score of 9 and the chain saw gets an 8 since diagnostics are sometimes required.

Disposability is viewed from the operator's point of view. The axe and the cross- cut, when too rusty or broken to use any more, are taken to the local scrap yard. The axe head brings fifty cents and the cross-cut blade brings twenty five cents. The old chain saw can be sold to a local proprietor who pays five dollars for the parts since he runs a repair shop. Thus, the Disposability scores are 6, 7 and 8 for the axe, cross-cut saw and chain saw, respectively.

The overall score for the axe is $9+4+9+6=28$, the overall score for the cross-cut is $8+5+9+7=29$, and the overall score for the chain saw is $5+9+8+8=30$. The chain saw approach wins here based primarily on superior Operability obtained at the expense of lower Producibility and lower Reliability and Maintainability. If you have ever had to cut a number of trees yourself and then clean off the branches, you would probably agree with the outcome of this hypothetical trade study.

This example is, of course, greatly simplified. As mentioned before, a true Life Cycle Trade Tool Set would involve established metrics and computer programs from each discipline (where available), a function which mapped selected Measures Of Performance for a particular system type to Measures Of Effectiveness, subjective ranking where metrics or tools were not available, and an interdisciplinary weighting which could be adjusted according to the ground rules of the development team. And yet, the purpose of the realistic tool set would be much the same as the purpose of this hypothetical case.

Overview of RM&S/O Toolbox Recommended

The RM&S/O toolbox envisioned should act as a decision aid to guide NASA in the early phases of system development to choose design approaches which are best for the entire life cycle of the system. The toolbox should employ a graphical user interface common to modern desktop and laptop computers and even if some of the constituent tools are not graphically driven themselves, they should be executed from an integration program which is graphical. The toolbox integration program should not only produce a meaningful score for each system design alternative, but also a record which identifies and characterizes that design alternative and provides the reasons for the scores produced. A cost analysis of each alternative would be desirable, although it will probably depend heavily on parametric Cost Estimating Relationships. The user must be cautioned that the toolbox is a decision aid, not a decision maker; meant to supply insight, not directives.

A typical usage of the toolbox might proceed as follows: the user boots up his computer and clicks on the toolbox icon. He has the capability of managing files, where each file contains a trade study. He can add a new file, or delete, edit, or rename an old file. Each trade study file contains at least one design alternative, and may have several. Within the file, the user has the capability to add an alternative, or to delete, edit, or rename an existing alternative. Each file receives a name, date and description, and each alternative within a file receives a name, date and description. Subdirectories and file extensions are regulated by the toolbox integration program to maintain easy retrieval of work.

Suppose the user has already selected a trade study file to edit and he wishes to add a design alternative. After he has entered a name and a description he has the option to develop the Producibility, Operability, Supportability, or Disposability score. The Producibility tool will probably involve quite a bit of subjective ranking in the areas of system complexity and part count (which must pass on through to the Reliability scoring), tolerancing, materials and hazardous substances (which must pass on through to the Disposability scoring), and special production facilities required.

The Operability tool will require the user to tailor the trade by selecting a set of metrics appropriate to the system under development. For example, Radar Cross Section may not be of much interest in the development of a weather satellite but Total Weight would certainly be important. Total Weight may be very unimportant in a Radio Telescope project but Signal to Noise Ratio should be of great interest. This selection will have to be made a priori, or else the toolbox will have to accept only the intersection of metrics from each design alternative. This is to insure that the same set of Operability metrics are used for each alternative so that an "apples to apples" comparison may be assembled.

In our survey, the Supportability discipline seemed to be by far the best populated with analytical tools. The user will need a tool to assist in the computation of a Logistic

Reliability score (perhaps an overall MTBF), a Maintainability score (Mean Time To Repair), and a tool to score the size and expense of the Logistic Resources required. This would be a bare minimum but this would characterize the Supportability of the system design alternative.

The Disposability score would probably need to be a subjective ranking and consider materials and hazardous substances, salvage value, bio-degradability, recycleability and likely location of the system at time of expiration. The user would perhaps respond to an on-line questionnaire and background algorithms would then develop a score.

The weighting between the four disciplines of Producibility, Operability, Supportability, and Disposability must be established a priori; that is, before score calculation so as not to bias the final recommendation. The user can alter the weights to test the sensitivity of the different areas.

The toolbox should provide as output several types of information. The names, dates, and description of the trade study and each alternative should appear along with the final score for each alternative which amounts to a recommendation. For each alternative the score for each of the four disciplines, as well as important tool outputs and questionnaire results, should also appear to provide an audit trail for the final recommendation. Each alternative should receive a cost estimation, if possible.

This overview is by no means cast in concrete but provides a vision for a toolbox. The toolbox should help clarify requirements, guide the development process through a well-ordered trade study and balance the needs of the entire life cycle. Finally, the toolbox helps to build a case for the acquisition program and helps to answer the challenges of those who must make funding decisions.

PHASE II STUDY PLAN

Phase I results are sufficiently detailed to permit a succinct, yet fairly comprehensive description of the Phase II study plan. The plan can be briefly represented in the three activities listed below, followed by a Phase II Summary.

- Toolbox Recommendations (Make or Buy Analysis)
- Toolbox Integration & Development
- Implementation

The Toolbox Recommendations proceed from the results of the Phase I questionnaire which were processed into a database and scored according to suitability for the toolbox. Those tools and methods with the highest scores are candidates for recommendation for the toolbox. The recommendation does not follow automatically as the Uwaholi team would not wish to recommend two high-scoring tools that accomplished the same task. The recommended tools and methods must: (1) cover the disciplines mentioned in the RM&S/O paradigm with little or no overlap, (2) conform to the user interface standards mentioned in the RM&S/O toolbox overview and, (3) adhere to reasonable budgetary guidelines for tool acquisition or development. Some of the recommended tools will be used as they now exist and will constitute a "Buy" recommendation. Others will need some slight modification and will constitute a "Buy and Adapt" recommendation. Still others will not exist and will prompt a "Make"

recommendation which means the Uwaholi team will need to plan a development effort to fill the gap. It is important to realize that some of the "Buy" recommendations may have an acquisition cost of zero if the tool is in the public domain. The deliverable from this activity will be a recommendation list.

Toolbox Integration and Development should proceed naturally from the "Make or Buy" recommendations. After the recommendations are reviewed and comments and changes incorporated, the tools will collectively require a set of inputs and produce a set of outputs. Some of the outputs may actually become inputs to another toolbox program but others will contribute to the final score in each of the four primary disciplines: Producibility, Operability, Supportability, or Disposability. The algorithms to produce these scores and then to combine them into a total score must be developed as part of this integration effort. The method to collect inputs, manage the input files and provide default values must also be developed. Thus, the deliverable from this activity will be a network chart where the nodes are the various tools, methods, and integration algorithms in the toolbox, and the flow arrows are the important inputs and outputs; i.e., those that contribute to the final score for the design alternative under consideration.

In the Implementation activity the team develops the necessary software to assemble the toolbox itself. The Uwaholi team proposes to develop "rapid prototypes" following the approval of the integration chart so that the appropriate personnel at the Marshall Space Flight Center can provide timely input for influencing the "look and feel" of the toolbox. This will also help the Uwaholi team to develop documentation or "Help" facilities which give maximum benefit to the user. The deliverable from this activity is the software which constitutes the actual RM&S/O toolbox.

Phase II Summary

Two activities form the Phase II Summary:

- Demonstration of Toolbox
- Final Presentation & Report

The Demonstration should be the last of a series of smaller demonstrations given during the rapid prototyping period of the Implementation. Those smaller demonstrations would primarily include potential users; the Final Demonstration would be regarded as a deliverable to show the capability of the toolbox as developed. The intent would be to gain approval of the work accomplished and to advertise the potential of the toolbox to assist in the development of space systems.

The Final Presentation and Report will supplement the Final Demonstration and will provide documentation for the toolbox. It will include the recommendation list, the integration network flow chart and an appendix describing installation and operation of the toolbox.

CONCLUSION

In the area of Pre-Concept and Concept Exploration system development, the Phase I effort accomplished the following research objectives, which were to:

- Assess the state-of-the-art in RM&S/O tools
- Assist NASA in developing an approach for tool acquisition
- Recommend a toolbox design and a plan to improve NASA's system development process

These accomplishments are limited to the early phases of the development process. As mentioned elsewhere in the report, there are many fine Reliability and Maintainability tools available for later detailed work, such as circuit board design tools, Weibull analysis and maintenance access simulations which are not appropriate for this toolbox.

The Phase I deliverables, including the questionnaire and the database of results, provides an insight into the state-of-the-art which is independent of any particular approach. This can be used as a starting point for other studies which have different but related objectives.

The paradigm described in this report offers a balanced approach to system evaluation taking into account the entire "cradle to grave" life cycle of the system. This approach enables a program manager to effectively and efficiently influence a development effort with a comprehensive range of issues under consideration to the benefit of those who will build, maintain, and operate the system in the future.

APPENDIX A
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(1) Mr. Rowlands was kind enough to respond and advise that this was not an area in which he did business.

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Management Sciences, Inc 1

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Organization Type: Industry

Tool ID	Tool Name
1001	Complex Block Diagram Evaluator
1002	Strategic Operational Safety (SOS)
1003	Logistics Engineering Workbench
1004	Maintainability Strategist
1005	Behavioral/Functional REALITY
1006	ARPA's RASSP System Engineering
1007	Strategic Test and Repair Simulator (STARS)
1008	ARPA's RASSP RAM-ILS Tool Set
1009	Behavioral/Functional Maintenance REALITY

General Comments

What is your definition of system operability?

The ability of the system to continuously perform behavioral requirements in a manner that meets or exceeds the requirements defined in the system specifications, e.g. A Spec, B Spec, B1 Spec, B2 Spec, SSS, etc.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

RM&S/O in pre-concept and concepts development and in systems engineering cannot be done in piecewise or in a vacuum. The Interoperability must be studied as well as the operability. The uniqueness of the space station precludes use of statistical or

Management Sciences, Inc 1

"average" deterministic methods. Specifications for RM&S/Operability must be well defined in the system requirements documents. Where possible, requirements should be stated with risk probabilities, confidence intervals, required, time sequences, penalties, loss potentials and other measures coincident with the text. Fault tree analysis and related techniques should be disallowed in favor of Time Domain Monte Carlo simulation with full sensitivity analysis.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Greg Barnett; RASSP Systems Engineering manager, (ARPA Contractor) Lockheed Martin Advanced Technology Laboratory, Camden NJ (609) 234-4234

Did we ask the right questions? If not, please suggest how we might improve this survey.

B+ Start out front to explain NASA's pro-active (reactive?) RM&S/O objectives. If NASA has a need for an integrated solution, say so. Similarly, if you have a requirements driven design as your basis, give a few examples to show the serious nature of the project analysis. If economic analysis is required due to small budget for ALPHA, add that as a requirement.

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1001 Complex Block Diagram Evaluator

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A time domain optimizing deployment simulator for multi-discipline RM&S/O system engineering

2. What is the name of this tool? Complex Block Diagram Evaluator

3. Is it identified by other names? Yes

If yes, please specify:

C-Block Diagram

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Management Sciences, Inc. Albuquerque NM

5. When was this tool developed or first used?

1994

6. What is the purpose of this tool?

CAD based systems engineering deployment simulator for RM&S/O. Converts behavioral requirements into deployment functional and implementations. Used for ongoing risk assessment using a time domain monte carlo simulation environment. Totally scaleable from very high level concepts at the enterprise level (e.g. Space Station) down to exacting detail in development of application specific signal processors embedded in integrated circuits.

7. What elements of RM&S/Operability does this tool cover?

Systems engineering for performance, RM&S/O. Time domain simulation and analysis based on strict requirements capture and traceability to assess an "executable mission scenario". Includes performance, behavioral definition, behavioral reliability, safety,

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functional reliability, hardware reliability, software reliability, human factors, RAM-ILS allocation, DCAS approved cost/benefit estimating

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

REALITY This tool is used to convert the requirements functional flow model (executable specification) to a complex deployment analysis diagram. The diagram is the basis for mission operability, availability, reliability, and coverage. Full import/export with structured query language (SQL) database transfers.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc.

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Benchmarks I and II by MIT Lincoln Laboratory US Navy Navair CAD II Demonstrations 1993

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance feasibility, architecture definition, architecture selection, deployment event confidence intervals, deployment cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

16. Who if anyone provides user support or upgrades for this tool?

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Management Sciences, Inc. Albuquerque NM

17. Does a database exist to support this tool? Please describe.

Yes

CAD environment with SQL - Oracle, Informix, ACCESS, etc.

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix, Other Normally using networked tools displaying in X-11 Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No VHOL and "C" compilers for interference modeling is allowed

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

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7. Please check the box which reflects the educational or professional background necessary for use of this tool.
General college or academic background, Design engineer background

8. Please check the box which reflects the ease of becoming an effective user, given the above background.
Very Easy

9. What would be the approximate cost to NASA to acquire this tool?
1001 - \$5000 per copy

10. What is the approximate annual cost of user support?
1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?
14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.
This tool set is most effective when reality is important, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?
Yes

14. If you can envision such a usage, how?
As the requirements driven, time domain mission simulation model for assessment of feasibility and requirements compliance.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?
Yes

Overall Assessment

63

Complex Block Diagram Evaluator (MSI) - This tool would indeed seem to be useful in NASA's system development efforts in the Pre-

Management Sciences, Inc 1

Concept and Concept Exploration stage; however, it is questionable whether this tool would be suitable for the envisioned tool set. This is because C-Block Diagram is a CAD based tool and might thus be difficult to integrate with other tools in a single workstation. It is also a Monte Carlo simulation, which may also pose integration difficulties. If this model is necessary to "fill a gap" in the tool set, these possible integration challenges must be resolved.

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1002 Strategic Operational Safety (SOS)

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A tool for optimizing test and diagnostic strategies for multi-discipline RM&S/O

2. What is the name of this tool? Strategic Operational Safety (SOS)

3. Is it identified by other names? Yes

If yes, please specify:

System Safety Tool

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Management Sciences, Inc., Albuquerque, NM

5. When was this tool developed or first used?

1994

6. What is the purpose of this tool?

Requirements driven safety and hazard simulation tool used to determine functional feasibility to achieve safety goals. Performs time domain assessment with believability basis. Uses a behavioral CAD based systems engineering deployment simulator for RM&S/O. Prepares allocations of functionality to achieve functional and hardware safety.

7. What elements of RM&S/Operability does this tool cover?

Systems behavioral and functional safety strategy development for pre-concept, concept, and detailed design phases of development. Uses behavioral definitions of performance, RM&S/O. Time domain simulation and analysis based on strict requirements capture and traceability to assess an "executable mission scenario". Includes

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performance, behavioral definition, and behavioral safety and pre-diagnosis in robotic and unassisted, and human assisted modes.

**8. If this tool is not a model, does it support a model?
Yes If so what is the name of that model?**

REALITY This tool is used to convert the requirements functional flow model (executable specification) to a complex deployment analysis CAD diagram. The diagram is the basis for operability, availability, supportability, safety, and maintenance. Full import/export with structured query language (SQL) database transfers.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc.

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Aircraft Certification

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance feasibility, architecture definition, architecture selection, deployment event confidence intervals, deployment cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Beech Starship

16. Who if anyone provides user support or upgrades for this tool?

Management Sciences, Inc., Albuquerque NM

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17. Does a database exist to support this tool? Please describe.

Yes

Falcon Framework and SQL - RDB, DB2, Oracle, Informix, ACCESS, etc.

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No VHOL and "C" compilers for interference modeling is allowed

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

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General college or academic background , Design engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

1001 - \$5000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This tool set is most effective during pre-concept and related system engineering tasks, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O behavioral safety requirements. The tool set is designed to be used in a multi-disciplined systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As the requirements driven, time domain mission behavior simulation model for assessment of feasibility and requirements compliance

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

63

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Strategic Operational Safety (SOS) (MSI) - Certainly, system safety is of high priority to NASA, and the acquisition phase applicability of this tool is appropriate. The fact that SOS is a CAD based simulation may pose integration difficulties for inclusion in a tool set.

Management Sciences, Inc 1

1003 Logistics Engineering Workbench

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other , An application interface toolbox with SQL Database

2. What is the name of this tool? Logistics Engineering Workbench

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Digital Equipment Corporation

5. When was this tool developed or first used?

1994

6. What is the purpose of this tool?

Tool integration engine with application interface for hypertext, database, analysis tools, report generators, data management, flow manager.

7. What elements of RM&S/Operability does this tool cover?

Systems engineering definition, operational configuration, Logistics Support Analysis, structural tracking, Database manager, tool set interface

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

RASSP Design Framework and REALITY simulation models

9. In which phase of the acquisition life-cycle is this tool the most useful?

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Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Digital Equipment Corporation

11. Is it available for others to use?

Yes , As COTS Tool set

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. DOD JCALS and US Army MERSA

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Productivity, Relevance to equipment and mission configurations, mockups, and tool integration.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

JCALs Project, USAF JPATS Aircraft

16. Who if anyone provides user support or upgrades for this tool?

Digital Equipment Corporation

17. Does a database exist to support this tool? Please describe.

Yes

SQL - Oracle, Informix

18. What specific data must be collected or available for operating this tool?

Minimum: Space Station equipment breakdown structure based on proposed deployment configuration.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

Management Sciences, Inc 1

2. What type of operating system is required?

Windows, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No External compilers are allowed, but not normally a part of this tool set.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

40000+ kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

No special background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

Management Sciences, Inc 1

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This tool set provides the application interface and structural data reference for the analysis of the space station. It has the ability to integrate any and all tools in a common desktop.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As the database and application interface for multi-discipline engineering analysis and documentation of the space station. It is integrated with the Management Sciences REALITY tools, and the logistics support analysis tool set by Digital

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

65

Logistic Engineering Workbench (DEC) - This tool does not so much lend itself to serve as a tool set component as it does a tool set integration package. Thus, this would be used to link together other "application" tools. It may not link them precisely the way NASA wants them linked, however, and so must be further investigated.

Management Sciences, Inc 1

1004 Maintainability Strategist

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A time domain tool for optimizing maintenance strategies for multi-discipline RM&S/O

2. What is the name of this tool? Maintainability Strategist

3. Is it identified by other names? Yes

If yes, please specify:
System Maintainability

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Management Sciences, Inc., Albuquerque, NM

5. When was this tool developed or first used?
1994

6. What is the purpose of this tool?
Requirements driven maintenance methodology that uses democratic simulation to determine functional feasibility to achieve availability goals. Performs complete deployment assessment with believability bases. Uses a behavioral CAD based systems engineering deployment simulator for RM&S/O. Prepares allocations of functionality to achieve functional maintainability. Totally scaleable from very high level concepts at the enterprise level (e.g. Space Station) to any lower level.

7. What elements of RM&S/Operability does this tool cover?
Systems behavioral and functional maintenance engineering for pre-concept, concept, and detailed design phases of development. Uses behavioral definitions of performance, RM&S/O. Time domain

Management Sciences, Inc 1

simulation and analysis based on strict requirements capture and traceability to assess an "executable mission scenario". Includes performance, behavioral definition, and behavioral maintenance in robotic, unassisted, and human assisted modes.

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

REALITY This tool is used to convert the behavioral requirements functional flow model (executable specification) to a complex deployment analysis CAD diagram. The diagram is the basis for operability, availability, supportability, and maintenance. Full import/export with structured query language (SQL) database transfers.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc.

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results.

Benchmarks I and II by MIT Lincoln Laboratory, US Navy NAVAIR CAD II Demonstration 1993

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance feasibility, architecture definition, architecture selection, deployment event confidence intervals, deployment cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

Management Sciences, Inc 1

16. Who if anyone provides user support or upgrades for this tool?

Management Sciences, Inc., Albuquerque NM

17. Does a database exist to support this tool? Please describe.

Yes

Falcon Framework and SQL - RDB, DB2, Oracle, Informix, ACCESS, etc

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No External compilers are allowed, but not normally a part of this tool set.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Management Sciences, Inc 1

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background, Design engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

1001 - \$5000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This tool set is most effective during pre-concept and related system engineering tasks, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O behavioral requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As the requirements driven, time domain mission behavior simulation model for assessment of feasibility and requirements compliance

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Management Sciences, Inc 1

Yes

Overall Assessment

63

Maintainability Strategist (MSI) - This tool appears to be useful for the Supportability section of the envisioned tool set. The fact that it is a CAD based Monte Carlo simulation would possibly make it difficult to integrate into a tool set in an efficient manner.

1005 Behavioral/ Functional REALITY

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A time domain tool for optimizing maintenance strategies for multi-discipline RM&S/O

2. What is the name of this tool? Behavioral/ Functional REALITY

3. Is it identified by other names? Yes

If yes, please specify:
REALITY

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Management Sciences, Inc., Albuquerque, NM

5. When was this tool developed or first used?
1994

6. What is the purpose of this tool?
Requirements driven reliability methodology that uses democratic simulation to determine functional feasibility to achieve availability goals. Performs complete deployment assessment with believability bases. Uses a behavioral CAD based systems engineering deployment simulator for RM&S/O. Prepares allocations of functionality to achieve functional maintainability. Totally scaleable from very high level concepts at the enterprise level (e.g. Space Station) to any lower level.

7. What elements of RM&S/Operability does this tool cover?
Reliability Systems engineering for pre-concept, concept, and detailed design phases of development. Uses behavioral definitions of performance, RM&S/O. Time domain simulation and analysis

Management Sciences, Inc 1

based on strict requirements capture and traceability to assess an "executable mission scenario". Includes performance, behavioral definition, and behavioral reliability

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?

REALITY This tool is used to convert the behavioral requirements functional flow model (executable specification) to a complex deployment analysis CAD diagram. The diagram is the basis for operability, availability, supportability, and maintenance. Full import/export with structured query language (SQL) database transfers

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Benchmarks I and II by MIT Lincoln Laboratory, US Navy NAVAIR CAD II Demonstrations 1993

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance feasibility, architecture definition, architecture selection, deployment event confidence intervals, deployment cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

Management Sciences, Inc 1

16. Who if anyone provides user support or upgrades for this tool?

Management Sciences, Inc., Albuquerque NM

17. Does a database exist to support this tool? Please describe.

Yes

SQL - Oracle, Informix, ACCESS, etc.

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No VHOL and "C" compilers for interference modeling is allowed

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

Management Sciences, Inc 1

7. Please check the box which reflects the educational or professional background necessary for use of this tool.
General college or academic background, Design engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.
Very Easy

9. What would be the approximate cost to NASA to acquire this tool?
1001 - \$5000 per copy

10. What is the approximate annual cost of user support?
1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?
14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.
This tool set is most effective during pre-concept and related system engineering tasks, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O behavioral requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?
Yes

14. If you can envision such a usage, how?
As the requirements driven, time domain mission behavior simulation model for assessment of feasibility and requirements compliance

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?
Yes

Overall Assessment

63

Behavioral/Functional REALITY (MSI) - This tool appears to be useful for the Supportability section of the envisioned tool set. The fact that it is a CAD based Monte Carlo simulation would possibly make it difficult to integrate into a tool set in an efficient manner.

Management Sciences, Inc 1

1006 ARPA's RASSP System Engineering

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, An environment for distributed multi-discipline RM&S/O system engineering

2. What is the name of this tool? ARPA's RASSP System Engineering

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

\$54M Advanced Research Projects Agency (ARPA) contract to Lockheed Martin

5. When was this tool developed or first used?

1994

6. What is the purpose of this tool?

CAD based systems engineering deployment simulator for RM&S/O. Based on configuration managed virtual prototyping and ongoing risk assessment using a time domain monte carlo simulation environment. Totally scaleable from very high level concepts at the enterprise level (e.g. Space Station) down to exacting detail in development of application specific signal processors embedded in integrated circuits.

7. What elements of RM&S/Operability does this tool cover?

Total systems engineering for performance, RM&S/O. Time domain simulation and analysis based on strict requirements capture and traceability to assess an "executable mission scenario". Includes performance, behavioral definition, behavioral reliability, safety,

Management Sciences, Inc 1

functional reliability, hardware reliability, software reliability, human factors, RAM-ILS allocation, DCAS approved cost/benefit estimating

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

Any computer model through IDEF driven linkage based in the RASSP enterprise data management system. Full import/export with structured query language (SQL) database transfers.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development

10. Who owns (or controls) this tool?

Consortium headed by LMATL

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Benchmarks I and II by MIT Lincoln Laboratory

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance, confidence intervals, cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

16. Who if anyone provides user support or upgrades for this tool?

Commercial Off the Shelf Tool providers. Management Sciences Inc., Lockheed Martin, Aspect Development etc.

Management Sciences, Inc 1

17. Does a database exist to support this tool? Please describe.

Yes

SQL - Oracle, Informix, ACCESS, etc.

18. What specific data must be collected or available for operating this tool?_

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No External compilers are allowed but not normally a part of this tool set, Mathcad and other tools allowed

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

40000+ kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Management Sciences, Inc 1

General college or academic background

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

\$50000+ per copy

10. What is the approximate annual cost of user support?

5001 - \$10000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This tool set is most effective when reality is important, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As the unified design environment and assurance environment. Provides requirements driven, integrated, proven virtual design systems engineering environment with appropriate tools for space mission RAM and Integrated Logistic Support using time domain mission simulation model

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

63

Management Sciences, Inc 1

ARPA's RASSP System Engineering Tool set (MSI) - This program is more of a tool set than a tool. Its comprehensive capability makes it a tool of interest, certainly, since it addresses reliability, safety, human factors, and costing. The fact that it is a CAD based Monte Carlo simulation would possibly make it difficult to integrate into a tool set in an efficient manner.

Management Sciences, Inc 1

1007 Strategic Test and Repair Simulator (STARS)

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A tool for optimizing test and diagnostic strategies for multi-discipline RM&S/O

2. What is the name of this tool? Strategic Test and Repair Simulator (STARS)

3. Is it identified by other names? Yes

If yes, please specify:
System Testability Tool

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Management Sciences, Inc., Albuquerque NM

5. When was this tool developed or first used?
1994

6. What is the purpose of this tool?
Requirements driven diagnosability methodology that uses democratic simulation tool used to determine functional feasibility to achieve safety and maintenance goals. Performs complete testability assessment with believability basis. Uses a behavioral CAD based systems engineering deployment simulator for RM&S/O. Prepares allocations of functionality to achieve functional and hardware testability.

7. What elements of RM&S/Operability does this tool cover?
Systems engineering for performance, RM&S/O. Time domain simulation and analysis based on strict requirements capture and traceability to assess an "executable mission scenario". Includes performance, behavioral definition, behavioral reliability, safety,

Management Sciences, Inc 1

functional reliability, hardware reliability, software reliability, human factors, RAM-ILS allocation, DCAS approved cost/benefit estimating.

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?

REALITY This tool is used to convert the behavioral requirements functional flow model (executable specification) to a complex deployment analysis CAD diagram. The diagram is the basis for mission operability, availability, supportability, and maintenance. Full import/export with structured query language (SQL) database transfers.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. US ARMY ATO/ATO

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance feasibility, architecture definition, architecture selection, deployment event confidence intervals, deployment cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

16. Who if anyone provides user support or upgrades for this tool?

Management Sciences, Inc 1

Management Sciences, Inc., Albuquerque NM

17. Does a database exist to support this tool? Please describe.

Yes

Falcon Framework and SQL - RDB, DB2, Oracle, Informix, ACCESS, etc

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No VHOL and "C" compilers for interference modeling is allowed

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

Management Sciences, Inc 1

7. Please check the box which reflects the educational or professional background necessary for use of this tool.
General college or academic background, Design engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.
Very Easy

9. What would be the approximate cost to NASA to acquire this tool?
1001 - \$5000 per copy

10. What is the approximate annual cost of user support?
1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?
14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.
This tool set is most effective when reality is important, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a “space system” development?
Yes

14. If you can envision such a usage, how?
As the requirements driven, time domain mission behavior simulation model for assessment of feasibility and requirements compliance

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?
Yes

Overall Assessment

63

Management Sciences, Inc 1

Strategic Test And Repair Simulator (STARS) (MSI) - This is a testability model, and in complex, software-intensive systems, testability analysis should be moved upward in the development process. Therefore, this may have applicability for the NASA tool set. The fact that it is a CAD based Monte Carlo simulation would possibly make it difficult to integrate into a tool set in an efficient manner.

Management Sciences, Inc 1

1008 ARPA's RASSP RAM-ILS Tool set

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology, An environment for distributed multi-discipline RM&S/O system engineering

2. What is the name of this tool? ARPA's RASSP RAM-ILS Tool set

3. Is it identified by other names? Yes

If yes, please specify:

REALITY

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

\$54M Advanced Research Projects Agency (ARPA) contract to Lockheed Martin

5. When was this tool developed or first used?

1994

6. What is the purpose of this tool?

CAD based time domain monte carlo simulation for RM&S/O and Testability. Based on high level, top-down configuration managed virtual mission simulation. Totally scaleable from very high level concepts at the enterprise level (e.g. Space Station) down to exacting detail in development of application specific signal processors embedded in integrated circuits.

7. What elements of RM&S/Operability does this tool cover?

Virtual Deployment Analysis in Deployment Scenario, Time domain mission event and safety simulation Behavioral functionality, operability, reliability, Defect simulation, fault injection and fault handling High level failures, Failure Modes Effects Criticality

Management Sciences, Inc 1

Analysis, Discrete Event Simulation for continuous process (NASA method), Diagnosibility, testability, repairability, maintainability, supportability, Hardware and software reliability (multiple methods), Human factors and Maintenance Analysis, LSA, and Cost

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

RASSP design environment model

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc

11. Is it available for others to use?

Yes, As COTS Tool set

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. RASSP Benchmarks I and II by MIT Lincoln Laboratory

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Productivity, Relevance to mission reality, effectiveness, requirements compliance, confidence intervals, cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

RASSP Project, JPATS Aircraft, Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

16. Who if anyone provides user support or upgrades for this tool?

Management Sciences Inc, Lockheed Martin, etc.

17. Does a database exist to support this tool? Please describe.

Yes

Management Sciences, Inc 1

SQL - (Oracle, Informix, ACCESS, etc.)

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission definitions as complex diagram schematics. Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No External compilers are allowed but not normally a part of this tool set.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

5001 - 10000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

No special background required

Management Sciences, Inc 1

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

5001 - \$10000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This tool set is most effective when reality is important, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As CAD based unified, requirements driven integrated, systems engineering environment simulation of space mission RM&S/O with cost trade offs, simulation model

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

65

ARPA's RASSP RAM-ILS Tool set (MSI) - This program is more of a tool set than a tool. Its comprehensive capability makes it a tool of interest, certainly, since it addresses FMECA, fault injection, testability, software reliability, ILS analysis, and costing. The fact

Management Sciences, Inc 1

that it is a CAD based Monte Carlo simulation would possibly make it difficult to integrate into a tool set in an efficient manner.

Management Sciences, Inc 1

1009 Behavioral / Functional Maintenance REALITY

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A pro-active time domain optimizing availability simulator for multi-discipline RM&S/O system engineering for redundant and self diagnosing situations

2. What is the name of this tool? Behavioral / Functional Maintenance REALITY

3. Is it identified by other names? Yes

If yes, please specify:
Functional Maintenance

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Management Sciences, Inc., Albuquerque, NM

5. When was this tool developed or first used?
1994

6. What is the purpose of this tool?
Requirements driven system availability simulation in internal (preventive-proactive) and external (human assisted) forms. This is a time domain monte carlo simulator using the operations paradigm. Uses democratic simulation to determine operational feasibility to achieve goals. Performs complete development assessment with believability basis. Uses a behavioral CAD based systems engineering deployment simulator for RM&S/O. Prepares allocations of functionality to achieve functional availability

7. What elements of RM&S/Operability does this tool cover?
Systems availability simulation and allocation for pre-concept, concept, and detailed design phases of development. Uses behavioral

Management Sciences, Inc 1

definitions of availability, performance, RM&S/O. Time domain simulation and analysis based on strict requirements capture and traceability to assess an "executable mission scenario".

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

REALITY This tool is used to convert the behavioral requirements functional flow model (executable specification) to a complex deployment analysis diagram. The diagram is the basis for mission operability, availability, reliability, maintainability, and coverage.
SQL - import/export

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

Management Sciences, Inc.

11. Is it available for others to use?

Yes, Beta sites activated, full commercialization 1Q96

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. RASSP Benchmarks I and II by MIT Lincoln Laboratory, US Navy NAVAIR CAD II Demonstrations 1993

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Effectiveness, requirements compliance feasibility, internal preventive solution, architecture definition, architecture selection, deployment event confidence intervals, deployment function availability, cost and risk.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Synthetic Aperture Array, Remotely Piloted Vehicle, US Navy shipboard defense system

Management Sciences, Inc 1

16. Who if anyone provides user support or upgrades for this tool?

Management Sciences, Inc.

17. Does a database exist to support this tool? Please describe.

Yes

SQL - Oracle, Informix, ACCESS, etc.

18. What specific data must be collected or available for operating this tool?

Minimum: Behavioral mission functional requirements; Preferred: Requirements documents (A, B, B-1, B-2, Systems Software Spec (SSS), etc.); Where possible: RM&S/O budgets, and candidate element historical data.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows, Power Mac, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No VHOL and "C" compilers for interference modeling is allowed

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

10000 - 40000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

Management Sciences, Inc 1

7. Please check the box which reflects the educational or professional background necessary for use of this tool.
General college or academic background, Design engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.
Very Easy

9. What would be the approximate cost to NASA to acquire this tool?
1001 - \$5000 per copy

10. What is the approximate annual cost of user support?
1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?
14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.
This tool set is most effective during pre-concept and related system engineering tasks, when the analysis must be consistent, managed, integrated to minimize costs while meeting RM&S/O behavioral requirements. The tool set is designed to be used in a multi-discipline systems engineering environment with full follow through to the delivered missions.

13. Can you envision this tool being applied during a "space system" development?
Yes

14. If you can envision such a usage, how?
As the requirements driven, time domain mission behavior simulation model for assessment of feasibility and requirements compliance

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?
Yes

Overall Assessment

63

Behavioral/Functional Maintenance REALITY (MSI) - This tool may be useful for the Supportability section of the envisioned tool set. The fact that it is a CAD based Monte Carlo simulation would possibly make it difficult to integrate into a tool set in an efficient manner.

Teledyne Brown Engineering 2

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Organization Type: Industry

Tool ID	Tool Name
1010	Maintenance Prediction Software

General Comments

What is your definition of system operability?

Would you like to receive the results of this survey? No

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1010 Maintenance Prediction Software

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model, A Methodology

2. What is the name of this tool? Maintenance Prediction Software

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Teledyne Brown Engineering, Space Programs SRM Group

5. When was this tool developed or first used?

1991

6. What is the purpose of this tool?

To provide inputs to the detailed design approach, and to the detailed maintenance and support plan based on maintenance predictions. Provide maintenance results. The tool allows determination whether maintenance requirements will be achieved with the design and the described support personnel/skill requirement

7. What elements of RM&S/Operability does this tool cover?

Maintenance

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

Mil-HDBK-472 Proc II

9. In which phase of the acquisition life-cycle is this tool the most useful?

Demonstration/Validation, Full Scale Development, Operations, Modification

10. Who owns (or controls) this tool?

Teledyne Brown Engineering

11. Is it available for others to use?

No

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Calculations have been verified manually

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Station Flight Hardware

16. Who if anyone provides user support or upgrades for this tool?

None

17. Does a database exist to support this tool? Please describe.

Yes

NPRD-95, Mil-HDBK-217F, Space Station Program etc.

18. What specific data must be collected or available for operating this tool?

Failure rates, shutdown, safing times, remove, replace and checkout times.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes FileMaker Pro

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Logistician background required, General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

1001 - \$5000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Once data has been entered the software can provide IVA corrective maintenance prediction worksheets, IVA preventive maintenance worksheets, EVA corrective and preventive maintenance worksheets, IVA MMH/Y summary sheet, EVA MMH/Y summary sheet. Also each sheet has MMH/Y calcs, maintenance procedures, checkout plans, fault detection steps, shutdown safing procedures

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

It has already been used for space station flight hardware

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

4 1

Maintenance Prediction Software - This is a Mac tool for performing Maintainability Timeline Analysis. It is most applicable in Dem/Val and beyond. The tool has already been used to analyze Space station Flight hardware. It is worth further investigation.

McDonnell Douglas Aerospace 3

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Organization Type: Industry

Tool ID	Tool Name
1011	Critical Items Listing Database

General Comments

What is your definition of system operability?
The ability to perform as designed or desired repeatedly.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

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McDonnell Douglas Aerospace 4

Address Information:

Mr. Carmine Bailey
Manager, Systems Analysis and Simulations

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Work(205) 922-7130
Fax (205) 922-4526

E-Mail Address: bailey@apdsun01.mdc.com

Organization Type: Industry

Tool ID	Tool Name
1012	Hypermedia Electronic Life-cycle Program (HELP)

General Comments

What is your definition of system operability?

The process by which a system is brought online and put into operation.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

For any system in the early stages of development, the focus must be on collecting data and providing traceability of data up to the current development state of the system. This allows for better cost estimates, provides clear justification for the system development effort.

McDonnell Douglas Aerospace 4

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

McDonnell Douglas Aerospace 5

Address Information:

Mr. Mike Bangham

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Organization Type: Industry

Tool ID	Tool Name
1013	Optimized Advanced Systems Integration and Simulation (OASIS)
1014	McDonnell Douglas Human Modeling System (MDHMS)

General Comments

What is your definition of system operability?

The cost to maintain and operate a system after completion of the development and testing

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

See answer to "Did we ask the right questions" below.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Tools are a significant aspect of reducing life cycle costs to the taxpayer, but of more importance is the overall approach and focus of the developer. The survey should also address how to set up and provide incentives to accomplish lower life cycle costs. The automobile industry and commercial airplanes are good examples - people buy good products that last and are cheaper to maintain. Not clear how this can be applied to government programs with limited production cycles and limited number of options.

1014 McDonnell Douglas Human Modeling System (MDHMS)

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? McDonnell Douglas Human Modeling System (MDHMS)

3. Is it identified by other names? Yes

If yes, please specify:

MDHMS

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

McDonnell Douglas Corporation - Commercial Airplanes

5. When was this tool developed or first used?

N/A

6. What is the purpose of this tool?

MDHMS is an interactive computer program offering a wide range of options in graphical representations and methods of human factors analysis of human body fit and function.

7. What elements of RM&S/Operability does this tool cover?

Operability and maintainability

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Full Scale Development, Production, Operations

10. Who owns (or controls) this tool?

McDonnell Douglas Corporation

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Sold

commercially - not public domain

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results.

Validated by comparing to actual human factor applications on commercial airplanes

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ease of operations and maintenance of final product

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Commercial Airplanes MD-11, MD-80, Military Aircraft, Space Station EVA, Automobile industry, jet engine assembly

16. Who if anyone provides user support or upgrades for this tool?

McDonnell Douglas Corporation

17. Does a database exist to support this tool? Please describe.

Yes

Question is not clear but numerous applications do exist. Human factors data bases are used to define reach and strength.

18. What specific data must be collected or available for operating this tool?_

CAD geometry (IGES)

Resources Questions:

1. What type of computer is required for this tool?

Workstation

2. What type of operating system is required?

Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required, General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Significantly enhances human operations and allows maintenance tasks to be assessed during design to reduce maintenance costs and time.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

Currently being used on ISSA for EVA and IVA assessments. Can be used to assess RLV turn around activities and ground operations.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

40

Human Modeling System - This tool addresses the ergonomics portion of the RM&S/O problem. Its commercial availability, and proven use on commercial airlines programs makes it worthy of further consideration. Required data may limit it to only full scale development systems and therefore limit its' usefulness in the pre-concept and concept exploration phases of a program.

NASA MSFC/ED 62 6

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NASA MSFC/ED 62

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Organization Type: Government

Tool ID	Tool Name
1015	Fracture Control Program Requirements
1016	Guidelines for Loads Analyses and Dynamic Model Verification of Shuttle Cargo Elements
1017	SSF ECLSS Regenerative Subsystem Selection
1018	SSF Internal Maintenance Analysis
1019	Structural Strength Program Requirements
1020	Design and Verification Guidelines for Vibroacoustic and Transient Environments

General Comments

Note Mr. Owen was the ED point of contact for the MSFC S&E in-house survey. No definition for "Operability" or answers to the summary questions were provided.

What is your definition of system operability?

Would you like to receive the results of this survey?

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1015 Fracture Control Program Requirements

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Specification

2. What is the name of this tool? Fracture Control Program Requirements

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Durability Analysis Branch, ED25

5. When was this tool developed or first used?
1987

6. What is the purpose of this tool?
Establishes the fracture control requirements for all flight structures for which MSFC is responsible.

7. What elements of RM&S/Operability does this tool cover?
Reliability/Safety of flight structures

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Full Scale Development

10. Who owns (or controls) this tool?
N/A

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? N/A If so what are they?

13. Has this tool been validated or verified in any manner? N/A If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None known

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Shuttle SSME, Saturn, Skylab, others

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

N/A

18. What specific data must be collected or available for operating this tool?_

Various

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

N/A

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

The fracture control requirements are to be used throughout the design of any space flight structure.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

17

Fracture Control Program Requirements - This is a specification for fracture control requirements for space systems developed at MSFC. Knowledge of the specification may have value to developers in the pre-concept and concept exploration phases of the program however it really does not lend itself to toolbox inclusion.

1016 Guidelines for Loads Analyses and Dynamic Model Verification of Shuttle Cargo Elements

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Specification

2. What is the name of this tool? Guidelines for Loads Analyses and Dynamic Model Verification of Shuttle Cargo Elements

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Systems Response Branch, ED22 MSFC

5. When was this tool developed or first used?
1991

6. What is the purpose of this tool?
The guidelines are provided for loads analysis programs to support the designs and dynamic math model verification for the Space Shuttle cargo elements projects at MSFC

7. What elements of RM&S/Operability does this tool cover?
Reliability of cargo element systems

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Full Scale Development

10. Who owns (or controls) this tool?

N/A

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? N/A If so what are they?

13. Has this tool been validated or verified in any manner? N/A If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None known

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Shuttle

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

N/A

18. What specific data must be collected or available for operating this tool?_

Various

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

N/A

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

The guidelines set forth in this document are used to ensure successful mission performance of Space Shuttle cargo element systems when subjected to all Space Shuttle Vehicle quasi-static, dynamic, and thermal load environments.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

17

Guidelines for Loads Analyses and Dynamic Model Verification of Shuttle Cargo Elements - This is a document which might be useful to payloads that are intending to fly on the Shuttle and that are in the concept development phase. Usefulness for RM&S/O toolbox is support suspect.

1017 SSF ECLSS Regenerative Subsystem Selection

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? SSF ECLSS
Regenerative Subsystem Selection

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Life Support Branch (ED62) of the Marshall Space Flight Center

5. When was this tool developed or first used?
1986

6. What is the purpose of this tool?
The methodology was used to select the final baseline regenerative environmental control and life support subsystems (ECLS) from a group of competitive subsystem for the Space Station Freedom

7. What elements of RM&S/Operability does this tool cover?
The study considered resupply and return weight and volume over 10 years, including expendables and waste; safety, maintenance, maintainability, reliability, and complexity

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Demonstration/Validation

10. Who owns (or controls) this tool?

N/A

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None known

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Station Freedom Environmental Control and Life Support System

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

N/A

18. What specific data must be collected or available for operating this tool?_

In addition to the data specified in the "What elements of RM&S/Operability does this tool cover?", quantitative values for launch weight and volume, power required, heat rejection are required. Qualitative values for technical maturity, integration issues, noise, microgravity sensitivity, technology problems, contamination potential, performance, commonality, and other misc. factors are required.

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Other, Use of this methodology requires a extensive background in the life support technologies of interest, not only, to gather the specified data, but also to understand potential system integration issues and problems.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Difficult

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The specific methodology used is appropriate for the final selection of the baseline regenerative environmental control and life support subsystems (ECLS) from a group of competitive subsystems for manned space habitat. One key aspect of the process not mentioned elsewhere is the testing of competitive subsystem in a "head-to-head" manner, from which much of the performance data was derived.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As mentioned above, this methodology used is appropriate for the final selection of the baseline regenerative environmental control and life support subsystem (ECLS) from a group of competitive subsystems for a manned space habitat. The methodology is adaptable to many other applications, and the general approach has undoubtedly been used widely.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

19

SSF ECLSS Regenerative Subsystem Selection - Interesting methodology used in the selection of the ECLS. Its use in the toolbox is not readily apparent.

1018 SSF Internal Maintenance Analysis

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? SSF Internal Maintenance Analysis

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
SSF In-Flight Maintenance Working Group (MSFC was lead center)

5. When was this tool developed or first used?
1989

6. What is the purpose of this tool?
The methodology was used to quantify and optimize the internal maintain demand for on-orbit crew time on the Space Station Freedom

7. What elements of RM&S/Operability does this tool cover?
On-orbit maintenance of the Space Station Freedom

8. If this tool is not a model, does it support a model?
Yes If so what is the name of that model?
Reliability and Maintainability Assessment Tool (RMAT)

9. In which phase of the acquisition life-cycle is this tool the most useful?
Full Scale Development

10. Who owns (or controls) this tool?

Loral Space Information Systems

11. Is it available for others to use?

Unknown

12. Are there any restrictions or constraints on others using this tool? Unknown If so what are they?

13. Has this tool been validated or verified in any manner? Unknown If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None known

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Station Freedom Environmental Control and Life Support System

16. Who if anyone provides user support or upgrades for this tool?

Unknown

17. Does a database exist to support this tool? Please describe.

Unknown

18. What specific data must be collected or available for operating this tool?

This method requires, for each orbital replacement unit, the following data: MTTR (Mean time to repair), MMH (Maintenance Manhours), MTBF (Mean Time Between Failure), MTBPM (Mean time between preventive maintenance), Life, Mass

Resources Questions:

1. What type of computer is required for this tool?

Unknown

2. What type of operating system is required?

Unknown

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Unknown

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

Unknown

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

Unknown

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Unknown

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Unknown

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Unknown

9. What would be the approximate cost to NASA to acquire this tool?

Unknown

10. What is the approximate annual cost of user support?

Unknown

11. What is the approximate delivery time for this tool once requested by NASA?

Unknown

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The ED lab played a limited role in this study, primarily supplying data on the maintenance requirements of Life Support Hardware. Information on this method is being supplied as a courtesy.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

This methodology was used for the SSF internal maintenance and may be applicable to any manned space system.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

17

SSF Internal Maintenance Analysis - A methodology that might be useful for improving RM&S/O practices at MSFC. However, incorporation into a computer based toolbox is not readily apparent. The parent tool which this methodology supported, RMAT, needs further investigation.

1019 Structural Strength Program Requirements

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Specification

2. What is the name of this tool? Structural Strength Program Requirements

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Durability Analysis Branch, ED25

5. When was this tool developed or first used?
1981

6. What is the purpose of this tool?
The document above prescribes the general structural strength program requirements for contracts and MSFC in-house efforts involving the design, development, and fabrication of aeronautical and space systems and elements thereof.

7. What elements of RM&S/Operability does this tool cover?
Reliability, safety, and service life is addressed

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Full Scale Development

10. Who owns (or controls) this tool?

N/A

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? N/A If so what are they?

13. Has this tool been validated or verified in any manner? N/A If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None known

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Shuttle SSME, Saturn, Skylab, others

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

N/A

18. What specific data must be collected or available for operating this tool?_

Various

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

N/A

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

N/A

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

The structural strength program requirements are to be used throughout the design of any aeronautical and space system and elements thereof.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

17

Structural Strength Program Requirements- This is a specification for structural strength requirements for space systems developed at MSFC. Knowledge of the specification may have value to developers in the pre-concept and concept exploration phases of the program however it really does not lend itself to toolbox inclusion.

1020 Design and Verification Guidelines for Vibroacoustic and Transient Environments

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Specification

2. What is the name of this tool? Design and Verification Guidelines for Vibroacoustic and Transient Environments

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Component Analysis Branch, ED23, MSFC

5. When was this tool developed or first used?
1986

6. What is the purpose of this tool?
The guidelines are provided for the application of vibroacoustic and transient technology used by ED23 to all launch vehicle and payload components managed by NASA/MSFC

7. What elements of RM&S/Operability does this tool cover?
Reliability of launch vehicle and payload components

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

9. In which phase of the acquisition life-cycle is this tool the most useful?
Full Scale Development

10. Who owns (or controls) this tool?

N/A

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? N/A If so what are they?

13. Has this tool been validated or verified in any manner? N/A If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None known

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Shuttle SSME, Saturn, Skylab, others

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

N/A

18. What specific data must be collected or available for operating this tool?_

Various

Resources Questions:

1. What type of computer is required for this tool?

Other, N/A

2. What type of operating system is required?

Other

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

N/A

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

MSFC has been extremely successful in the vibroacoustic design and verification of the flight hardware for these programs

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

The MSFC approach is based on 25 years of experience in developing large launch vehicles and payloads, many of which were man-rated.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

17

Design and Verification Guidelines for Vibroacoustic and Transient Environments - This is a specification for vibroacoustic and transient environments requirements for space systems developed at MSFC. Knowledge of the specification may have value to developers in the pre-concept and concept exploration phases of the program however it really does not lend itself to toolbox inclusion.

NASA MSFC/EP 42 7

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Organization Type: Government

Tool ID	Tool Name
1021	MSFC Enhanced Failure Environment Analysis Tool
1022	Extend Process Flow Simulation

General Comments

What is your definition of system operability?

The ability to support required flight rates and schedules and to meet a variety of operational demands. Encompasses notions of availability, dependability, flexibility, capability, surge, and others

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Since data is difficult to come by in launch vehicle applications models should be logical and provide sensitivities; absolutes not possible early on

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Not that I know of.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Perhaps add a question on advantages/disadvantages of model/tool and ask about what models/tools rejected during selection process (and why)

1021 MSFC Enhanced Failure Environment Analysis Tool

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? MSFC Enhanced Failure Environment Analysis Tool

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Original package without enhancements Lockheed, With enhancements EP42

5. When was this tool developed or first used?
1990

6. What is the purpose of this tool?
Design Reliability

7. What elements of RM&S/Operability does this tool cover?

Reliability Analysis

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?

Most models are supported but best fit is Digraph and failure propagation logic modeling

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation

10. Who owns (or controls) this tool?

MSFC/EP42

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they? Only learning curve constraints

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Used on several programs (original program) including STS, Space Station Enhancement V&V'd internally

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Credibility of result, traceability of result, extent of documentation; ease of use; comprehensiveness in analysis.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

STS, Space Station, RLV, NLS

16. Who if anyone provides user support or upgrades for this tool?

Currently - EP42

17. Does a database exist to support this tool? Please describe.

Yes

Depends upon application. SSME data can support first historical cut at new engine concept.

18. What specific data must be collected or available for operating this tool?

generally leaf node failure rate information, supports probabilistic analysis if data appropriate

Resources Questions:

1. What type of computer is required for this tool?

Personal, Currently McIntosh

2. What type of operating system is required?

McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

1001 - 2000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Extensive mathematics or statistics background required, Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Very Effective - allows quantification of failure propagation logic models with appropriate data. This capability is only available in high end reliability tools (very expensive)

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

We are using it in X-33 tasks

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

50

MSFC Enhanced Failure Environment Analysis Tool - Failure analysis and reliability analysis tool. Its' availability, low cost, and operations on a personal computer make this a tool worthy further consideration.

1022 Extend Process Flow Simulation

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A Model, A Process

2. What is the name of this tool? Extend Process Flow Simulation

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Imagine That Corp

5. When was this tool developed or first used?

1980

6. What is the purpose of this tool?

Provide a way to model process flows including timelines and resource requirements

7. What elements of RM&S/Operability does this tool cover?

Operability, maintainability, and logistics (parts of)

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation

10. Who owns (or controls) this tool?

Imagine That Corp

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Commercial Product

13. Has this tool been validated or verified in any manner? Not Sure If yes, please describe the method and results. Sold as a commercial product

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ease of use, appropriateness of output; applicability to system being modeled

15. Please list examples of programs, projects, systems or products that this tool has been used on. SSME, NLS, RLV

16. Who if anyone provides user support or upgrades for this tool?

Imagine That Corp

17. Does a database exist to support this tool? Please describe.

Yes

EP42 has STS engine & MPS database

18. What specific data must be collected or available for operating this tool?

need appropriate process info.

Resources Questions:

1. What type of computer is required for this tool?

Personal, PC or McIntosh

2. What type of operating system is required?

Windows, McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Logistician background required, Extensive mathematics or statistics background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

30+ days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Extend - Good effective simulation tool

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Used for X-33 tasks

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

55

Extend is a Windows and McIntosh based discrete event modeling and simulation software package. This easy to use package has obvious application in the RM&S/O area even in the early concept exploration phases of a program. Its low cost and multi platform capability makes it worthy of further consideration for including it within the toolbox.

NASA MSFC/EL22 8

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E-Mail Address:

Organization Type: Government

Tool ID	Tool Name
1023	Witness

General Comments

What is your definition of system operability?

The ability of a system to achieve its' operations requirements at minimum cost. Alternatively the term "supportability" could be used to address the same concerns.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Suggest focusing on "supportability" in lieu of trying to develop a new term such as "operability"1) supportability addresses key issues of low cost ops & maint2) supportability processes exist and are understood. 3) supportability tools exist

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1023 Witness

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? Witness

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
AT&T ISTEEL

5. When was this tool developed or first used?
1985

6. What is the purpose of this tool?
To Simulate and Analyze Processes

7. What elements of RM&S/Operability does this tool cover?
Operations and Logistics

8. If this tool is not a model, does it support a model?
N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operations

10. Who owns (or controls) this tool?
MSFC/EL22

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Limited to one user at any time

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. By vendor plus wide industry usage

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Most useful in evaluation of alternative concepts and related trade studies

15. Please list examples of programs, projects, systems or products that this tool has been used on.

New Tool - Currently being used on SSFF Maintenance analysis

16. Who if anyone provides user support or upgrades for this tool?

Vendor

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?_

Process Times, MTBF, MTTR

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

5001 - 10000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

4001 - 8000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Very useful tool for simulating and analyzing operations processes including the associated support activities. Graphical displays provide for easy interpretation / analysis. Processes can be optimized by sensitivity analysis techniques.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Simulation of operations concepts

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

56

Witness is a Windows based discrete event modeling and simulation software package. This easy to use package has obvious application in the RM&S/O area even in the early concept exploration phases of a program. Cost is a concern for including it within the toolbox.

Innovative Software Designs, Inc.9

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E-Mail Address:

Organization Type: Industry

Tool ID	Tool Name
1024	Relex Reliability Software

General Comments

What is your definition of system operability?

The ability of the system to perform its task for the entire mission.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Perform reliability predicitions and FMECAs as early as possible to try to truly effect the design

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Can always cal me w/any questions

Did we ask the right questions? If not, please suggest how we might improve this survey.

Innovative Software Designs, Inc.9

1024 Relex Reliability Software

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Procedure

2. What is the name of this tool? Relex Reliability Software

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Innovative Software Designs, Inc.

5. When was this tool developed or first used?
1986

6. What is the purpose of this tool?
Calculate the reliability, MTBF, and MTTR of systems. Perform Failure Modes, Effects & Criticality analysis

7. What elements of RM&S/Operability does this tool cover?
Reliability & Maintainability prediction, FMECAs

8. If this tool is not a model, does it support a model?
Yes If so what is the name of that model?
Supports Mil-HDBK-217, Bellcore, MIL-STD-1629, MIL-HDBK-472

9. In which phase of the acquisition life-cycle is this tool the most useful?
Full Scale Development

10. Who owns (or controls) this tool?

Innovative Software Designs, Inc.9

Innovative Software Designs, Inc.

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Can only be used by purchasers of the tool.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Results validated by Innovative Software Designs in conformance with test procedures

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?
Compare the time savings vs. doing the analyses another way and see the results of improving reliability and pen pointing critical failures

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Many, very widely used tool in both military & commercial projects

16. Who if anyone provides user support or upgrades for this tool?

Innovative Software Designs

17. Does a database exist to support this tool? Please describe.

Yes

The Relex libraries provide an extensive amount of device data.

18. What specific data must be collected or available for operating this tool?

Data on parts used in the design

Resources Questions:

1. What type of computer is required for this tool?

Personal

Innovative Software Designs, Inc.9

2. What type of operating system is required?

Windows, McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

4001 - 8000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

No special background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

5001 - \$10000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Innovative Software Designs, Inc.9

The Relex Reliability Software allows the user to quickly and efficiently perform reliability and maintainability analyses. It is very well supported by Innovative Software Designs and has a very large following.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Reliability and Maintainability predictions & FMECAs all of which are critical to space system development.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

57

Relex Reliability Software (Innovative Software Designs, Inc.) - This is a procedure to perform R&M analysis on a system in Full Scale Development. That may make its applicability too late for the NASA tool set. It is a PC Windows tool, but somewhat expensive. It may be advantageous to see this software run to determine if any of the approach would be helpful in the tool set.

USASSDC 10

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Organization Type: Government

Tool ID	Tool Name
1025	COCOMO

General Comments

What is your definition of system operability?

The set of compatible situations which when occurring together prevent a system from failing or being considered economically or functionally not feasible.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Perform software sizing study to determine feasibility of cost, size (manpower), and facility planning.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

USASSDC10

Did we ask the right questions? If not, please suggest how we might improve this survey.

USASSDC 10

1025 COCOMO

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? COCOMO

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Barry Boehme TRW US Army

5. When was this tool developed or first used?

1982

6. What is the purpose of this tool?

To determine man hours required to develop and support through life cycle software in system

7. What elements of RM&S/Operability does this tool cover?

Manpower costs, facility sizing requirements, overall life-cycle support costs

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operations, Modification, Disposal

10. Who owns (or controls) this tool?

USASSDC 10

US Government

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. By US Army

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?
savings at systems closure versus predicted costs

15. Please list examples of programs, projects, systems or products that this tool has been used on.
USASSDC - LCSEC

16. Who if anyone provides user support or upgrades for this tool?

Teledyne Brown Engineering probably can

17. Does a database exist to support this tool? Please describe.

No

Provide your own as follows

18. What specific data must be collected or available for operating this tool?_

Software source lines of code vendor estimates

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

USASSDC 10

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

No special background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

I had a preliminarily approved TD of 950 new hires approved with an approved and funded PMA as well as Prelim. Design for a 250,000 sq ft facility based on the COCOMO manpower estimate

USASSDC 10

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Determine basic feasibility, Approx Cost (Manpower) (facility)

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

55

COCOMO (U.S. Space and Strategic Command) - This is a software support cost estimating methodology. It is a PC Windows tool, and inexpensive and easy to use. It ought to be further investigated for the toolbox.

General Atomics 11

Address Information:

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General Atomics

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E-Mail Address: rodriguez@vaxd.gat.com

Organization Type: Industry

Tool ID	Tool Name
1026	Control Development Simulator

General Comments

Public release authorized only with prior consent.

What is your definition of system operability?

A system that is completely and clearly observable and controllable

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Define operating sequences early, and the role of the operator for every design basis event. Make sure that clear visibility is given to operator of conditions during events that are beyond the design basis, and then define mitigation options for operators.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

INPO (Institute of Nuclear Power Operations) EPRI (Electric Power Research Institute)

General Atomics 11

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

TFW Sciences 12

Address Information:

Mr. Theodore Weber, Jr.
Owner/President

TFW Sciences

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Toluca Lake CA 91602

Phone Numbers:

Work (818) 980-8679

E-Mail Address:

Organization Type: Industry

Tool ID	Tool Name
1027	Real World Analysis of Reliability and downtime (REWARD)

General Comments

What is your definition of system operability?

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in its development cycle.

The early use of a "proven" model will materially improve the operability of a new vehicle. I've seen many projects where, in the final analysis, the vehicle failed to do what it was supposed to do. Reason: the tools used were inappropriate, and the R&M data which "drove" them was illconceived.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Survey is quite thorough. I'd like to suggest, however, that where a respondent claims to have a certain capability in his tool, can he demonstrate that this capability has indeed been incorporated? Does he have supporting documentation available to support such claims? With REWARD, I possess inputs and outputs which demonstrate the vailidity of my claims (both in terms of what it does, how it does it & what its been used for). Also quite often, the original tool programmers have long-since moved on. Upgrades and enhancements are very risky under these conditions. With REWARD, every line of code was developed by T.F. Weber (& he can explain what each does, and why).

SoHaR Inc. 13

Address Information:

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Fax (213) 653-3624

E-Mail Address: tang@sohar.com

Organization Type: Industry

Tool ID	Tool Name
1028	MEADEP (Measure Dependability)

General Comments

What is your definition of system operability?

I am not familiar with this term. I think it means system performance, system reliability, system availability, and system maintainability.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in its development cycle.

Previous failure rate data or experience data on the same or similar components of the system to develop are important for early assessment of system dependability.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

No

Did we ask the right questions? If not, please suggest how we might improve this survey.

You need to define operability. The term dependability has been widely accepted by the international fault-tolerant computing community. You may want to consider to use this term. The concept of "dependability" was proposed at the 15th international Symposium on Fault-Tolerant computing in 1985 [Laprie85].

Dependability is defined as the "quality of the delivered service such that reliance can be justifiably placed on this service." The dependability impairments are faults, errors, and failures. The means to achieve dependability is through fault avoidance and fault tolerance. Two major measures of dependability are reliability and availability. [Laprie85] J.C. Laprie, "Dependable Computing and Fault Tolerance: Concepts and Terminology," Proceedings of the 15th International Symposium on Fault-Tolerant Computing, pp 2-11 June 1985.

1028 MEADep (Measure Dependability)

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? MEADep (Measure Dependability)

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
SoHaR Inc.

5. When was this tool developed or first used?
1997

6. What is the purpose of this tool?
To support licensing decisions for commercial grade equipment in nuclear safety and control systems. Also applicable to other critical digital systems used in commercial and government sectors such as air traffic control and digital automotive equipment.

7. What elements of RM&S/Operability does this tool cover?
Measurement-based dependability analysis. The tool can be used to evaluate system reliability and availability measures based on operational failure data.

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?
The tool supports Markov chains, reliability block diagrams, and k-out-of-n models.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Operations

10. Who owns (or controls) this tool?

SoHaR Inc.

11. Is it available for others to use?

Yes, 1997

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results. Will be validated or verified against results evaluated from other tools such as SAS and SHARPE.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Measurement-based evaluation criteria such as if the tool can derive from actual data objective reliability and availability assessments.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

The methodology which is the foundation of the tool has been used to evaluate dependability for several air traffic control and nuclear safety systems: ISSS, VSCS, Eagle 21, etc.

16. Who if anyone provides user support or upgrades for this tool?

SoHaR Incorporated

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

The following data items are recommended to be collected: Report Number or Event ID, Occurrence Date and Time, Event Duration, Event Category (hardware, software, operator, etc.), Event Location

(CPU, memory, software unit name, etc.) Device Affected (processor or device number), Criticality (covered, non-covered, etc.)

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes Microsoft Access is recommended for use in preparing input data.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

8001 - 16000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

5001 - \$10000 per copy

10. What is the approximate annual cost of user support?

11. What is the approximate delivery time for this tool once requested by NASA?

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The tool, to implement our measurement-based methodology, will provide systematic and objective evaluation of reliability and availability and will help identify problem areas for the measured system. The user-friendly interface of the tool and the provisions of a library of dependability models will greatly reduce the requirements for sophisticated data processing and modeling skills from users.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

The tool can be used for any critical digital systems in the space application. For the digital system or subsystem to evaluate, failure data collected during testing or normal operation of the system can be input to the tool provided that a dependability model has developed for the system. The tool will provide a library of dependability models which may provide an appropriate skeleton for the modeled system. The output of the tool will be desired dependability measures.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

43

MEADEP is a dependability measurement system primarily targeted at critical digital systems. Tool is still in development, however, the methodology which MEADEP implements has been used on other systems. Tools is targeted at the measurement of actual system performance in actual operations and not at concept exploration or pre-concept exploration activities.

U.S. Army Communications-Electronics Command 14

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Chief, Systems Analysis Division

U.S. Army Communications-Electronics Command

AMSEL-PE-SA
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E-Mail Address: priceb@doim6.monmouth.army.mil

Organization Type: Government

Tool ID	Tool Name
1029	Achieving a System Operational Availability Requirement model (ASOAR)

General Comments

What is your definition of system operability?

System operability is a combination of system effectiveness parameters. These parameters include performance effectiveness which is the capability to perform the mission, the reliability which is the probability of the system not failing during the mission and the operational availability/readiness of the system which is the probability of the system being usable or up at any random point in time.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Apply the ASOAR model. Contact CECOM for the model, documentation and any assistance.

U.S. Army Communications-Electronics Command 14

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

No

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

U.S. Army Communications-Electronics Command 14

1029 Achieving a System Operational Availability Requirement model (ASOAR)

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model, Incorporated in a computer program

2. What is the name of this tool? Achieving a System Operational Availability Requirement model (ASOAR)

3. Is it identified by other names? Yes

If yes, please specify:

ASOAR

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

US Army CECOM

5. When was this tool developed or first used?

1993

6. What is the purpose of this tool?

ASOAR optimally allocates a total system operational availability requirement to the major end items comprising the system. Its purpose is to integrate early-on Logistics Support Analysis (LSA) with system level reliability, availability and maintainability analysis. ASOAR also provides a modeling link to optimize sparing and LSA to the system requirements.

7. What elements of RM&S/Operability does this tool cover?

Input elements are system operational availability, a reliability block configuration of end items, estimates of each end item's reliability, maintainability and cost, and supply and maintenance data for determining the mean time to obtain LRU spares. Outputs tell whether the system design and support plan can achieve the system

U.S. Army Communications-Electronics Command 14

AO requirement. Other outputs are the effective system reliability and maintainability, optimal end item operational availability/readiness allocation requirements, and the end item Line Replaceable Unit (LRU) order fill rates and associated logistics downtimes to achieving each AO

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

The COMPASS model which optimizes end item maintenance concepts to achieve the ASOAR specified AO and Sparing to Availability models (e.g. SESAME) which optimizes end item supply support to achieve each ASOAR specified AO.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development.

10. Who owns (or controls) this tool?

US Army CECOM

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Test of optimum operational availability proration against the SESAME model. Also, a documented redundancy methodology verification test.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Operation availability/readiness of the system.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

The Corp/Theater ADP Service Center and the Regency Net Communication System

U.S. Army Communications-Electronics Command 14

16. Who if anyone provides user support or upgrades for this tool?

US Army CECOM. Individuals who can provide support are Christine Shin, Peter Daniledes or Bernard Price. Phone Number (908) 532-8752.

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

A system operational availability, a reliability block configuration of end items, estimates of each end item's reliability, maintainability and cost, and supply and maintenance data for determining the mean time to obtain LRU spares.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

DOS, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

None Although ASOAR is programmed in FORTRAN, a FORTRAN compiler is only needed by CECOM for configuration changes. The users are provided an executable version that does not need any compiler or additional software.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

U.S. Army Communications-Electronics Command 14

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

ASOAR is a macro-level tool that applies a top down analytical approach to estimate optimal end item operational availability goals from the system operation availability requirement. Improves RAM Rationale Analysis. Provides the earliest-on-impact analyses of the system design and logistics concepts being considered.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

The tool is generic and can be applied to most systems

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

U.S. Army Communications-Electronics Command 14

Yes

Overall Assessment

46

Achieving a System Operational Availability Requirement (ASOAR) (U.S. Army CECOM) - This tool is free, it addresses the RMS issues, and is applicable during early acquisition phases. It is a Unix and DOS based PC tool. It should definitely receive further attention for the tool set.

Daina 15

Address Information:

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Owner and President

Daina

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Organization Type: Industry

Tool ID	Tool Name
1030	CARMS

General Comments

What is your definition of system operability?

We distinguish several levels of operability -- from fully operational to various levels of degradation. We cover this topic in detail in our book on reliability analysis (included with the CARMS program).

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Buy CARMS and use it

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

***Daina* 15**

It depends on what kind of information you are looking for. If you are not sure, then it really does not make that much difference.

1030 CARMS

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? CARMS

3. Is it identified by other names? Yes

If yes, please specify:

Markov Reliability Analysis Program

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

DAINA - Our own internal development

5. When was this tool developed or first used?

1989

6. What is the purpose of this tool?

Reliability, maintainability and effectiveness analysis of complex fault tolerant systems.

7. What elements of RM&S/Operability does this tool cover?

Reliability, availability, effectiveness, safety, logistics, etc.

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

Markov model

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration Validation, Full Scale Development, Production, Operations, Modification, Disposal

10. Who owns (or controls) this tool?

DAINA

11. Is it available for others to use?

Yes. It is a commercial tool. Presently it is being used in approximately 50 locations. Some of their CARMS users include MITRE, Draper Labs, Bell Labs, Lawrence Livermore, Intel, Digital, E-Systems, Hughes, Tandem, Stratus, etc. The majority of our users are high-tech commercial companies, involved in the design of complex fault-tolerant system. We are not aware of any NASA users at this time.

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they?

The need to purchase a licensed copy. For details see our WEB site: <http://WWW.umn.edu/nlhome/m121/puk/carms.htm>

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results.

It was verified against analytical solutions

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Used in the analysis of complex fault tolerant systems. We are not aware of all of the applications, because the majority of them are proprietary. One typical example is reliability analysis of the Air Traffic Control (ATC) systems.

16. Who if anyone provides user support or upgrades for this tool?

DAINA

17. Does a database exist to support this tool? Please describe.

Yes

We are including a comprehensive library of reliability models (about 50) as a part of the CARMS program.

18. What specific data must be collected or available for operating this tool?_

System architecture and failure rates for individual components.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No CARMS includes an embedded expert system (PROLOG style) for handling more difficult tasks.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

4001 - 8000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required, Military background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

Daina 15

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Very Effective and economical to use.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

Reliability analysis based on Markov modeling was already used during NASA Voyager program. Since space systems are complex and highly redundant CARMS would be a logical choice.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

58

CARMS appears to cover a large number of the necessary elements envisioned to be apart of the RM&S/O toolbox. As mentioned Markov modeling has been used effectively in the reliability field. CARMS price and computer requirements fits within the envisioned framework. Worth further evaluation for toolbox inclusion.

Digital Equipment Corporation 16

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FAX (508) 952-3023

E-Mail Address: mark.roth@tay.mts.dec.com

Organization Type: Industry

Tool ID	Tool Name
1031	Logistics Engineering Workbench and Integrated Construction Tool Set

General Comments

What is your definition of system operability?

The degree to which a system can be satisfactorily and effectively used with considerations given to cost, reliability, maintainability, supportability, ease of use, availability and accuracy.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Numerous commercial computer-based models and tools have been developed to aide the system design process. Unfortunately, most operate on a stand-alone basis. In order to improve the ability to access the overall RM&S/Operability of a system in any phase of it's Life-Cycle you must integrate your independently selected tools and models into a single client/server environment that provides

concurrent access to the tools and concurrent access to the data in a consistent database.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

William Jones Naval Sea Logistics Center Mechanicsburg, PA 17055-0795 Phone (717) 790-3206

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

1031 Logistics Engineering Workbench and Integrated Construction Tool Set

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? Logistics Engineering Workbench and Integrated Construction Tool Set

3. Is it identified by other names? Yes

If yes, please specify:

LEWB and ICTS

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Digital Equipment Corporation

5. When was this tool developed or first used?

1993

6. What is the purpose of this tool?

The purpose is to provide you with a tool that combines the principles of Continuous Acquisition and Life-Cycle Support (CALs), Concurrent Engineering, and Logistics Support Analysis to create an integrated system. It provides a customizable GUI workbench with the functionality to integrate your independently selected tools into a central relational database. It is a total solution running on a distributed client/server, open system that allows tools to share data. This eliminates data redundancy and increases data accuracy. Users have the capability of integrating third party tools and in-house tools so users can access a choices of tools and databases from a single menu on a single system. It provides you with a method to prevent the use of separate stand-alone tools that render redundant information.

7. What elements of RM&S/Operability does this tool cover?

This tool covers all the elements of RM&S/Operability by not only allowing independent selection of models and tools but by also linking them together with a database and consistent access through an easy to use GUI.

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?

This Integration and LSAR database tool can support any model by providing a single consistent method of access to the model and the input data for that model. This increases effective utilization of the models and increases data integrity and ease of data input.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration Validation, Full Scale Development, Production, Operations, Modification, Disposal

10. Who owns (or controls) this tool?

Digital Equipment Corporation

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. The LSAR database module of this tool has been validated by LOGSA and is a fully certified 1388-2b system. The flexibility and customization capabilities provided by the Integration and GUI creation modules bring it way beyond this validation.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Our method of determining value of the tools is based on rough calculations made in the workplace especially in the areas of start-up, Training, and user productivity. Our experience leads us to believe that start-up costs are 50% less, training costs are 50% less, and end-user productivity is 30% - 40% greater, and integration implementation costs/time are 1/4 - 1/3 faster. This data compares

the methodology stated here against methodologies and tools that it replaced.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Navy Undersea Warfare Center, Newport R.I., Torpedoes and Targets
Rockwell Tulsa Manufacturing Facility, Integrated product design efforts at GM, Alternative ILS methodologies at Shorts Bros, Management of certification processes i.e. aircraft certification analysis

16. Who if anyone provides user support or upgrades for this tool?

Digital Equipment Corporation

17. Does a database exist to support this tool? Please describe.

Yes

Yes a truly relational database using Oracle or VMSrdb.

18. What specific data must be collected or available for operating this tool?

The definition of the intended business practices including the expected employee behavior that is to be encouraged and supported

Resources Questions:

1. What type of computer is required for this tool?

Workstation, Other Because this tool uses client/server and object oriented technology it requires a workstation as a server and/or clients but Personals can be used as clients within this integrated environment.

2. What type of operating system is required?

Unix Other - In addition to UNIX it is available on VMS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes MOTIF, Oracle 7 or VMSrdb and C

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

4000 - 8000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Moderate

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Other - This software package has different levels of users and therefore requires various backgrounds. The background of the users of the development module for creating custom GUI's and tool Integration are: Knowledgeable workstation users familiar with system integration and application development. The background of the end users of the workbench environment (the integrated models, tools and database access functions) are users familiar with the subject matter of the models, tools and data along with some past exposure to a windows computer interface.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy

10. What is the approximate annual cost of user support?

\$10000+ per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Eliminates data redundancy and increases data accuracy. Reduces the incorporation of stand-alone, separate tools which render the same information. Database access is invisible to end users. Sharing data increases productivity and decreases costs. Easy to use menu driven point and click GUI. Reduces training time by using single front-end linking multiple tools and models. Tool access and data access is the same regardless of the system they are kept on. Customization and integration can be done by person with no programming experience. Creates object oriented GUI's without programming hundreds of lines of code. Use your legacy tools and/or third part tools of your choice. Dynamically add new tools from multiple vendors to address rapidly changing needs.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

As a single front-end Workbench with an object oriented GUI providing integration between model, tools and a distributed database. A client/server environment that would cause the flow of information from a single source through the life-cycle and shared by tools and multiple disciplines. It would be used to reap the benefits mentioned above and lead to a system of complete operability as defined in the operability definition provided.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

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Logistics Engineering Workbench and Integrated Construction Tool Set - This tool does not so much lend itself to serve as a tool set component as it does a tool set integration package. Thus, this would be used to link together other "application" tools. It may not link them precisely the way NASA wants them linked, however, and so must be further investigated.

Technology Associates 17

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Organization Type: Industry

Tool ID	Tool Name
1032	Functional Relationships Knowledge Based

General Comments

What is your definition of system operability?

We define system "operability" as the index or measure of the ability of a system to meet the quantitative (1) reliability, (2) availability, (3) safety and (4) system performance requirements at a cost affordable to users of or customers for the goods or services provided by that system. We consider high reliability, maintainability and supportability as being constituent attributes of operability.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

NASA, DOD and industrial organizations comprising the aerospace industry universally agree that maximum operability can only be achieved by design for operability beginning in the concept definition phase and continuing throughout all phases comprising the

full life-cycle of the system. The FRKB tool was developed specifically for the purpose of providing a tool that would support all the multidisciplinary activities comprising the life-cycle of a space vehicle systems. Implicit in the FRKB and applications capabilities goals is providing open but controlled access to and the ability to work in real or near real time with very large, continuously evolving, heterogeneous information base characteristic of complex systems. In addition to providing support and assistance to the multidisciplinary line organizations, a major design goal of the FRKB and its applications is to reduce or eliminate the barriers to rapid, comprehensive, effective and accurate communication within and between line organizations and project management organizations over the full life-cycle of complex systems development, production and operation.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

None at this time.

Did we ask the right questions? If not, please suggest how we might improve this survey.

The questions asked were unusually appropriate to the problem being investigated when compared to other such surveys we have seen in the past. When considering the additional questions that the survey form suggests, they appear to us to be more appropriate to a next survey or other form of more detailed evaluation of candidate tools for use by NASA MSFC.

1032 Functional Relationships Knowledge Based

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other The "tool" is a uniquely organized and structured language system and a computer based algorithm, or logical procedure, based on that language system. The "tool" enables the creation of a uniquely structured computer database. That database, similar in some aspects to a "knowledge base" in the context of "expert systems", when combined with applications programs, similar in some aspects with "inference engines" or "inference program" in "expert system", can generate or support, to a significant extent, the creation, preparation or generation of: 1) Models, 2) Simulations, 3) Process descriptions, process procedures and digital process control programs 4) Simulations, 5) Specifications preparation 6) Procedures development including writing 7) Other applications

2. What is the name of this tool? Functional Relationships Knowledge Based

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

U.S. Naval Research Laboratory (Mr. William J. D. Escher and Mr. Richard W. Foster)

5. When was this tool developed or first used?

1957

6. What is the purpose of this tool?

1. To reduce or eliminate the barriers to the rapid, integrated use of information contained in basically incompatible and continuously evolving engineering drawings and other forms of descriptions of the operation of complex systems 2. To enable this information to be

utilized by multidisciplinary teams or organizations in all phases of the life-cycle of complex systems. 3. To accomplish these purposes in a digital computer environment.

7. What elements of RM&S/Operability does this tool cover?

The tool was designed to: 1) Be applicable over the full life-cycle of complex systems generally and space vehicle system in particular including initial concept definition and alternatives evaluation. 2) Meet the requirement of the multiple disciplines characteristic of complex systems including the disciplines or management, science, engineering, manufacturing or production, test and checkout and operation. This includes meeting the general requirement for the evaluation of alternatives using multiple evaluation criteria in the multiple disciplines involved over the full life-cycle of complex systems.

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?

The tool supports that computer based generation of a multiplicity of models. The FRKB was designed to enable and support computer based applications programs capable of creating "transportable" or "standard": 1. Work breakdown structures (WBS) 2. Cost accounting structures, 3. Risk accounting structures 4. Reliability accounting structure 5. Weight breakdown/accounting structure, 6. The technological system related cost accounts structure of the business operation, 8) Algorithmic paths to the development of highly autonomous systems 9. Others in an "open architecture" computer environment capable of supporting widely distributed heterogeneous user systems.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Other The tool was designed to be applicable during all phases of the full-life cycle of the development of complex systems generally and space vehicle systems in particular. The tool has been designed to be capable of being continuously evolved beginning in the concept definition phase where data and other system defining information is incomplete and of a preliminary nature through the subsequent phases where data and other system defining information becomes increasingly complete and subject to increasingly "tight" configuration management and control.

10. Who owns (or controls) this tool?

Richard W. Foster

11. Is it available for others to use?

Yes The tool will be available to any users from an established company in the field of open architecture based computer assisted systems engineering and design tools with an established worldwide sales and product support infrastructure.

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Those associated with the use of proprietary and copyrighted commercial software products.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. The FRKB methodology, and applications, has been verified on: 1. The single stage VIKING high altitude sounding rocket 2. The three stage VANGUARD satellite launching vehicle 3. The SATURN S-I Stage of APOLLO Vehicle SA-8 1. All system comprising the single stage VIKING high altitude sounding rocket: The graphical language and algorithm was developed and successfully applied to describe the operation of, and inter dependencies between, all vehicle systems, subsystems, assemblies and components of the VIKING high altitude sounding rocket from launch sequence start to payload release. The physical proof was the production of the "VIKING Sequence Diagram" document. 2. All system comprising the three stage VANGUARD satellite launching vehicle: The graphical language and algorithm was successfully applied to describe the operation of, and inter dependencies between, all vehicle systems, subsystems, assemblies and components of the VANGUARD three stage satellite launch vehicle. The physical proof was the delivery of the "Vanguard Sequence Diagram". 3. All systems comprising the SATURN S-1 stage of APOLLO Vehicle SA-8: The graphical language and algorithm was successfully applied to describe the operation of, and inter dependencies between, all systems, subsystems, assemblies, and components comprising the SATURN S-1 stage of the APOLLO SA-8 vehicle. The physical proof was the delivery of the manually prepared "Integrated Operational Sequence Analysis" or "IOSA" of that vehicle stage by the Chrysler Corporation, Michoud LA, to SFC's propulsion and Vehicle Engineering Laboratory. The graphical language and algorithm was translated to digital computer program form and successfully applied to describe the operation of, and inter

dependencies between, all stage systems, subsystems and assemblies of the SATURN S-I stage of the APOLLO SA-8 launching vehicle. Two additional languages and algorithms were developed and successfully implemented to describe: 1. The physical interconnection paths (electrical, hydraulic, pneumatic, pyrotechnic, structural, or other) between components. This language system was referred to as the "Inter-Component" language system. 2. The quantitatively and time accurate dynamic performance of the components of the system. This language system was referred to as the "Intro-Component" language system. The physical proofs delivered as a result of this work included: 1. The computer generated and plotted Sequence Diagram of the operation of the S-1 stage of the APOLLO SA-8 vehicle from the start of the launch sequence to stage burnout. The plotted diagram served as a "proof" only. The diagram was physically 8 feet in width and over 24 feet in length. 2. An English language narrative description of the startup and operation sequence of H-1 engine subsystem of the SA-8. 3. Detailed component interconnect diagram, i.e., to the cable number, plug number and pin number level in electrical systems and the tube assembly number, and joint level in pneumatic and hydraulic systems. 4. Plotted, quantitative, time accurate descriptions of the dynamic relations occurring in and between multiple components included closed loop control of the startup and operation of an H-1 engine in the SA-8 vehicle.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? 1. Reducing the total life-cycle cost of the system 2. Providing new capabilities of significant value 3. Providing improved quality of the system products produced.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

1. The single stage VIKING high altitude sounding rocket. 2. The three stage VANGUARD satellite launching vehicle. 3. The SATURN S-1, Vehicle SA-8

16. Who if anyone provides user support or upgrades for this tool?

The tool will be fully supported and continuously upgraded by an established company with an existing worldwide support infrastructure.

17. Does a database exist to support this tool? Please describe.

No

There is no preexisting database involved in the methodology. The database is generated as a "co-product" of those activities comprising the engineering and design process. The method of development of the system descriptive database, the FRKB, was specifically designed to avoid the error sources and costs of an additional level of "interpretation" by specially trained or skilled personnel who are not directly responsible for the design of the components, assemblies, subsystems and system comprising the complex system or systems.

18. What specific data must be collected or available for operating this tool?

The primary data source required to construct the FRKB is the description of the functional operation of the parts comprising a system. Parts may be defined at any level of complexity or detail appropriate to the applications desired and the state of knowledge of the parts comprising that system. The preparation of the part description can be created by a number of different methods including a computer assisted, interactive entry system.

Resources Questions:

1. What type of computer is required for this tool?

Other Version 1.0, designed to meet the requirements of the system conceptual design phase, is implementable on either a personal computer or workstation depending upon the user's needs.

2. What type of operating system is required?

Windows Unix. Version 1.0 can operate under Windows or Unix depending upon the users needs.

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No No compilers or compilation operation or additional software is required to create the FRKB or use "standard" FRKB based application programs. The architecture of the FRKB is an "open" architecture supporting the development and use of application programs unique to specific users.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

\$50000+ per copy The cost of acquisition will be dependent upon the system size, number of parts comprising the system to be treated and the number and types of applications programs required.

10. What is the approximate annual cost of user support?

N/A The annual support cost will be dependent upon the number and types of applications programs required and number of seats, free standing or networked, required to be served. At the present time we estimate that the per seat cost will be in the \$5000-\$10000 per annum range.

11. What is the approximate delivery time for this tool once requested by NASA?

30+ days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Our experience with creating the FRKB for example systems and the complete APOLLO SA-8 first stage system and the development of example FRKB applications programs based on these databases demonstrated: 1. That the database structure works 2. That the database can be created by persons with skill levels generally available in the aerospace industry. "Specialists" or "experts" are not required. 3. The ability to integrate technical information derived from basically incompatible documentation and information forms and sources. 4. The ability to convert the detailed functional, interconnection and operation descriptive information contained in engineering drawing into digital data form using, and manipulable by, industry standard computer program techniques and processing platforms, (this is an information form conversion process - it is not an image conversion process) 5. The ability to manipulate that digital data using industry standard digital processing systems to provide information outputs in forms that would conventionally require human analysis, interpretation and restatement with attendant error sources. 6. Ease of access and high flexibility of application of the methodology in both incompletely defined systems and fully configuration controlled systems. The applications oriented example demonstrations of the effectiveness of the FRKB methodology described above represent only a limited number of examples.

13. Can you envision this tool being applied during a "space system" development?

This question has been addressed in prior and following responses to the survey.

14. If you can envision such a usage, how?

This question has been addressed in prior and following responses to the survey.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

34

The FRKB is more of a system development database / information system than an analytical tool. From the response to the survey the product appears to still be in the development stages. Using the

Technology Associates **17**

FRKB as a framework might be appropriate for the envisioned toolbox. Licensing, acquisition cost and support are significant issues.

US Army Missile Command 18

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Organization Type: Government

Tool ID	Tool Name
1033	Personal Computer Simulation Program with Integrated Circuit Emphasis (PSPICE)
1034	Design of Experiments Toolkit
1035	Mean Time Between Failure Prediction From ReliabilityBlock Diagram via Numerical Integration of System Reliability

General Comments

What is your definition of system operability?

Ability of a system to perform its job when required.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

No

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

US Army Missile Command 18

No

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

US Army Missile Command 18

1033 Personal Computer Simulation Program with Integrated Circuit Emphasis (PSPICE)

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation Personal computer simulation program with integrated circuit emphasis

2. What is the name of this tool? Personal Computer Simulation Program with Integrated Circuit Emphasis (PSPICE)

3. Is it identified by other names? Yes

If yes, please specify:
SPICE

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
It is an industry standard

5. When was this tool developed or first used?
1960

6. What is the purpose of this tool?
To simulate electronic circuits for design or analysis

7. What elements of RM&S/Operability does this tool cover?
Reliability and Operability

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

9. In which phase of the acquisition life-cycle is this tool the most useful?
Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operations, Modification, Disposal

US Army Missile Command 18

10. Who owns (or controls) this tool?

US Army MICOM (SEPD)

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

This is an industry standard, verification is not necessary

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? PSPICE is generally recognized as an effective simulation but it could be validated by a bench test.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

The following MICOM systems; TOW COBRA, UAV Hunter, PATRIOT PAC 3.

16. Who if anyone provides user support or upgrades for this tool?

Annual upgrades can be purchased through the vendor.

17. Does a database exist to support this tool? Please describe.

Yes

A library of 20,000 parts is part of the system.

18. What specific data must be collected or available for operating this tool?_

To simulate a circuit card, you must have the schematic diagram, the parts list and the specifications.

Resources Questions:

1. What type of computer is required for this tool?

Personal

US Army Missile Command 18

2. What type of operating system is required?

Windows NT

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

40000+ kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

8001 - 16000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Moderate

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required (EE)

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Difficult 6 months practices is required

9. What would be the approximate cost to NASA to acquire this tool?

5001 - \$10000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy \$1000/year

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

US Army Missile Command 18

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

PSPICE is the most cost effective tool for application. It allows us to analyze existing weapon system designs perform failure analysis and develop product improvements.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

To improve existing designs, or to be used on new designs, for analysis and failure analysis.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

48

PSPICE is a industry standard tool in the analysis and simulation of electronic circuits. Its emphasis on integrated circuit analysis, cost, and difficulty in use make it a unlikely candidate for the RM&S/O toolbox. Data from PSPICE analysis might be useful to support other tools in the toolbox.

Phase Three Logic 19

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Organization Type: Industry

Tool ID	Tool Name
1036	CAPFAST/SCAT

General Comments

What is your definition of system operability?

As it relates to SNEAK path analysis: Given all components of a system are operating - i.e. no part failures and /or back-up systems are on-line - SNEAK analysis will ensure that events take place when they should and prevent events from taking place when they should not.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

SNEAK analysis should be run on subsystem as they are developed. This will help reduce potential sneak paths when the sub-systems are combined.

Phase Three Logic 19

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1036 CAPFAST/SCAT

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? CAPFAST/SCAT

3. Is it identified by other names? Yes

If yes, please specify:

SCAT - Sneak Circuit Analysis Tool

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Rome Labs provided funding to SoHar Inc. Phase 3 helped to commercialize.

5. When was this tool developed or first used?

1995

6. What is the purpose of this tool?

Perform Sneak Circuit and Design Concept Analysis (DCA). DCA addresses Mil STD - 1543 B Appendix C.

7. What elements of RM&S/Operability does this tool cover?

Tool insures signals will occur when expected and unexpected signals will not occur.

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

We use term "model" to represent the devices being used in a design. The tool comes with a model library.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Phase Three Logic 19

Concept Exploration, Demonstration/Validation, Full Scale Development, Modification

10. Who owns (or controls) this tool?

SoHar / Phase Three Logic

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. DCA analyses cover Mil STD 1543B Appendix C

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? The tool keeps a session log of the analyses - identifies potential sneak paths and keeps track of what-if anything was done to eliminate the potential problems.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

To New.

16. Who if anyone provides user support or upgrades for this tool?

SoHaR and Phase Three Logic

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

Model for each device in the system. A library of models comes with the product. Users can create models that are not already in the library.

Resources Questions:

Phase Three Logic 19

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

800 - 16000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

5000 - \$10000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Safety and reliable operation of the system. Sneak circuits have been a factor in fatal and non-fatal aircraft incidents.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

The number of systems in a space system all connected can cause unwanted events to occur when switches are thrown. Also-if a switch is thrown and an event is expected to take place sneak circuits can prevent the event from taking place.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

55 |

CAPFAST/SCAT - A sneak circuit analysis tool used to improve the reliability of systems. A sneak circuit tool could be a useful inclusion in the RM&S/O toolbox. CAPFAST/SCAT is a commercial tool aimed at electronic circuit analysis. The sneak circuit analysis approach could be expanded to include other systems.

NASA/LaRC 20

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Organization Type: Government

Tool ID	Tool Name
1037	SLAM Simulation
1038	Logistics Tool
1039	Reliability, Maintainability, Analysis Tool (RMAT)

General Comments

What is your definition of system operability?

A qualitative measure of the inherent characteristics of a system to perform its function. These characteristics are quantitatively defined by the RM&S parameters. Together they provide a measure of the safety, cost and ease with which a system maybe operated.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Collect the type information needed to aid in the assessment/evaluation of new systems. It should be screened for errors, completed, and made available from a single source to all RM&S analyst.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1037 SLAM Simulation

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? SLAM Simulation

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
NASA, Space Systems and Concept Division, Vehicle Analysis Branch,
Nancy White

5. When was this tool developed or first used?
N/A

6. What is the purpose of this tool?
Assess the impact of operational scenario variations on support requirements.

7. What elements of RM&S/Operability does this tool cover?
Model results are scenario dependent and depend on input definition of flight rate and task durations. Output is in the form of resource requirements and facility utilization.

8. If this tool is not a model, does it support a model?
Yes If so what is the name of that model?
Reliability and Maintainability Model

9. In which phase of the acquisition life-cycle is this tool the most useful?
Pre-Concept, Concept Exploration, Operations

10. Who owns (or controls) this tool?

NASA, Langley Research Center

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

In-house studies - RLV, AMLS, PLS

16. Who if anyone provides user support or upgrades for this tool?

Simulation modification required for each study.

17. Does a database exist to support this tool? Please describe.

Yes

Aircraft & Shuttle R&M Characteristics

18. What specific data must be collected or available for operating this tool?

Typically processing flow, task durations, types of resources.

Resources Questions:

1. What type of computer is required for this tool?

Workstation

2. What type of operating system is required?

Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes SLAM, FORTRAN

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Moderate

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Other, need to have discrete event simulation background

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy SLAM software maintenance

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

N/A

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Assess the impact of operational scenario variations on support requirements

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

39

SLAM is a workstation based modeling and simulation software package. This robust package has obvious application in the RM&S/O area even in the early concept exploration phases of a program. Its costs and lack of multi platform capability makes other simulation tools more attractive for including it within the toolbox.

1038 Logistics Tool

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? Logistics Tool

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
LaRC/SSCD & Rockwell Int / Space Division

5. When was this tool developed or first used?
1994

6. What is the purpose of this tool?
To assess the "relative" costs of logistics support for future reusable launch vehicles / programs using conceptual level inputs

7. What elements of RM&S/Operability does this tool cover?
GSE, DSE, Transportation, Training Documentation, Warehousing, Consumables, Spares, Maintenance & Logistics Management

8. If this tool is not a model, does it support a model?
N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?
LaRC

11. Is it available for others to use?

No, In development

12. Are there any restrictions or constraints on others using this tool? N/A If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Where available shuttle data has been input as a test case. However, there were a significant number of inputs where engineering judgment had to be used.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? The model uses \$ year adjusted dollars as its only metric. It must be emphasized that these \$ are not absolute. With the lack of sufficient input data, only relative logistics assessments can be considered.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

In-house studies

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

Yes

A database was generated by RI using data they possessed where possible & engineering judgment elsewhere.

18. What specific data must be collected or available for operating this tool?_

Vehicle description, mission and the choice of support type typified by either aircraft or shuttle like environments.

Resources Questions:

1. What type of computer is required for this tool?

Personal MAC II ci or greater

2. What type of operating system is required?

McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes Microsoft Excel 4.0

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

N/A

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Still in development. Used as relative indicator of logistics support costs.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Still in development. Used as relative indicator of logistics support costs.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

35

Logistics Tool - Although still in development this tool deserves further investigation for inclusion in the toolbox. It address key elements in the overall Logistics Support Analysis area including maintenance management. Its' implementation in Excel means it is likely to be highly portable. Follow-up recommended.

1039 Reliability, Maintainability, Analysis Tool (RMAT)

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? Reliability, Maintainability, Analysis Tool (RMAT)

3. Is it identified by other names? Yes

If yes, please specify:

RAM Model

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

NASA, LaRC, SSCD, VAB, W. Douglas Morris

5. When was this tool developed or first used?

1991

6. What is the purpose of this tool?

To define R&M characterization of new launch vehicle concepts.

7. What elements of RM&S/Operability does this tool cover?

Turnaround operations missions.

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

Provides input to in-house simulation of conceptual level process flows.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

NASA/LaRC

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Prior written approval from the Vehicle Analysis Branch (VAB) of the NASA Langley Research Center

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. For aircraft systems, R&M predictions were checked against independent data for several aircraft types. Results within 20%. For Shuttle Orbiter results of manpower and processing times presented to KSC personnel. General agreement of top level results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? N/A

15. Please list examples of programs, projects, systems or products that this tool has been used on.

In-house studies, RLV

16. Who if anyone provides user support or upgrades for this tool?

LaRC/University of Dayton

17. Does a database exist to support this tool? Please describe.

Yes

Aircraft & Shuttle Orbiter R&M characteristics.

18. What specific data must be collected or available for operating this tool?

MTBMA, MH/OH, Removal Rates, and crew sizes for systems characteristics of launch vehicles or aircraft.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Other, DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes Quick Basic

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Difficult

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Difficult

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Other than engineering judgment no alternative exists for defining these characteristics at the conceptual level of study.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

To define the pre-conceptual and conceptual level R&M characteristics of new systems and support trade studies for these concepts.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

35

Reliability, Maintainability, Analysis Tool (RMAT) - This tool specifically addresses R&M characterization for space system in the early pre-concept and concept exploration phases. Its' implementation in Basic and ownership by NASA already makes this tool worthy of further investigation.

US Army Missile Command 2 1

Address Information:

Mr. Michael Doyle
Reliability Engineer

US Army Missile Command

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Organization Type: Government

Tool ID	Tool Name
1040	PGRACE: Prediction of Idealized Growth of Reliability and Confidence Estimation
1041	CASA
1042	SEQ4
1043	THRESH

General Comments

What is your definition of system operability?

We do not use this term. Our closest definition would probably be system availability - the probability that a system is up and available for use at a time in the future.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Reliability and maintainability should be designed-in to a system. The reliability of system design should be continually evaluated at every system design event and should be evaluated through analysis.

US Army Missile Command 21

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

US Army Material Systems Analysis Agency Rome Air Development Center

Did we ask the right questions? If not, please suggest how we might improve this survey.

US Army Missile Command 2 1

1040 PGRACE: Prediction of Idealized Growth of Reliability and Confidence Estimation

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? PGRACE: Prediction of Idealized Growth of Reliability and Confidence Estimation

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
US Army Missile Command

5. When was this tool developed or first used?
1991

6. What is the purpose of this tool?
To automate the calculations involved with the development of idealized reliability growth curves and estimation of lower confidence bounds associated with these curves.

7. What elements of RM&S/Operability does this tool cover?
Prediction of idealized growth of reliability and confidence estimation.

8. If this tool is not a model, does it support a model?
Yes If so what is the name of that model?
Duane model for reliability growth modified for single shot devices.

9. In which phase of the acquisition life-cycle is this tool the most useful?

US Army Missile Command 2 1

Dmonstration/Validation

10. Who owns (or controls) this tool?

US Army MICOM

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. It has been in use for many years and has been verified by using MICOM historical data.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? MTBF: Initial and final reliability in a developmental test or a final design.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Corps SAM, Patriot, THAAD, MLRS, LOS-F-N, UGV

16. Who if anyone provides user support or upgrades for this tool?

US Army MICOM

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?_

Failure data during developmental testing.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

US Army Missile Command 2 1

Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

US Army Missile Command 21

This tool automates formerly tedious calculations and allows the user to try out numerous scenarios without going through a lot of tedious calculations by hand.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

During the design stages

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

41

PGRACE: Prediction of Idealized Growth of Reliability and Confidence Estimation - A reliability growth analysis package developed by the government. This tool would probably be more useful in later stages of a program.

US Army Missile Command 21

1041 CASA

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? CASA

3. Is it identified by other names? Yes

If yes, please specify:

Cost Analysis Strategy Assessment

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Defense Systems Management College

5. When was this tool developed or first used?

N/A

6. What is the purpose of this tool?

Life Cycle Cost, trade-off analysis, risk and uncertainty analysis, reliability growth analysis, operational availability, O&S costs, warranty analysis, spares provisioning, cost drivers etc.

7. What elements of RM&S/Operability does this tool cover?

Reliability Growth and Operational Availability

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation

10. Who owns (or controls) this tool?

US Army Missile Command 2 1

US Army Material Command Logistics Support Activity

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? N/A If so what are they? No restrictions within Army. Outside is unknown

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Very effective for what if situations and for optimizing system reliability (availability)

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Used on several unmanned ground vehicle advanced concept studies and prototypes

16. Who if anyone provides user support or upgrades for this tool?

None

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?_

System description, R&M data, cost, maintenance concept, etc.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Other DOS

US Army Missile Command 2 1

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

501 - 1000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Logistician background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

30+ days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

US Army Missile Command 21

Allows us to model a system with advanced system data to determine best maintenance concept for optimum operational availability. Allows us to quantify effect of part quality and cost on operational availability and system life cycle cost.

13. Can you envision this tool being applied during a “space system” development?

Perhaps

14. If you can envision such a usage, how?

On non-flight, support equipment.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

40

CASA - Provides for the analysis and assessment of a system Life Cycle Cost from initial research through disposition, including operations and maintenance costs. Includes the capability to assess risk, sensitivities, and comparative analysis of the system. CASA is used throughout the DoD. Its' wide spread acceptance, applicability in the early concept stages, personal computer implementation, costs and availability makes CASA a strong candidate for possible toolbox inclusion.

US Army Missile Command 21

1042 SEQ4

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? SEQ4

3. Is it identified by other names? Yes

If yes, please specify:

Sequential Test Developer Version 2.21

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

US Army Belvoir Research, Development & Engineering Center

5. When was this tool developed or first used?

N/A

6. What is the purpose of this tool?

Develop & modify probability ratio sequential test plans. Also calculate operating characteristics (OC) curves. HAS Mil-HDBK-781 Test Plans

7. What elements of RM&S/Operability does this tool cover?

Test

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Demonstration/Validation

10. Who owns (or controls) this tool?

US Army Missile Command 2 1

Product Assurance Directorate

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they? To our knowledge there are no restrictions.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Mil-HDBK-781 test plans have been modeled and verified to be correct.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Time to prepare a test plan.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Used to determine recommended test plan for the UAV-CR system.

16. Who if anyone provides user support or upgrades for this tool?

None

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

Upper and lower test MTBF, Test Length, Number of Failures

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Other DOS

US Army Missile Command 2 1

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

SEQ4 allows the user to explore many test plan options so that test resources can be balanced against risks.

US Army Missile Command 21

13. Can you envision this tool being applied during a “space system” development?

Yes, For subsystems

14. If you can envision such a usage, how?

Develop acceptance test plans.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

43

SEQ4 - SEQ4 is a tool used to aid in the development of test plans.

Applicability to pre-concept and concept exploration RM&S/O toolbox not readily apparent.

US Army Missile Command 2 1

1043 THRESH

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? THRESH

3. Is it identified by other names? Yes

If yes, please specify:

GROSIG or WBPRGEN

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Army Materiel Systems Analysis Activity (AMSAA)

5. When was this tool developed or first used?

1988

6. What is the purpose of this tool?

Models the AMSAA continuous reliability growth curve and depicts user selected lower threshold values.

7. What elements of RM&S/Operability does this tool cover?

Reliability assessment

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

The AMSAA reliability growth model

9. In which phase of the acquisition life-cycle is this tool the most useful?

Concept Exploration, Demonstration/Validation, Full Scale Development

US Army Missile Command 2 1

10. Who owns (or controls) this tool?

AMSAA

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they? To our

knowledge there are no restrictions.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Duplicates the example case in Mil-HDBK-189

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Its value is in the time it saves in determining test threshold values (the thresholds are the lower confidence values for the instantaneous growth model.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Numerous MICOM systems

16. Who if anyone provides user support or upgrades for this tool?

No one

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

Starting point for reliability growth, test length, growth parameter, and desired threshold points.

Resources Questions:

1. What type of computer is required for this tool?

Personal

US Army Missile Command 2 1

2. What type of operating system is required?

Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

US Army Missile Command 21

Short of using Mil-HDBK-189 tables, very effective in determining a reliability growth test plan. It also allows sensitivity studies and parametric exercises to be conducted on the problem under consideration.

13. Can you envision this tool being applied during a “space system” development?

No

14. If you can envision such a usage, how?

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

43

THRESH - A reliability growth analysis program which primarily automates the use of Mil-HDBK-189 tables. Applicability in pre-concept and concept exploration phases of a program questionable.

Address Information:

Mr. Joe Alcock

United Technologies Pratt & Whitney

Phone Numbers:

E-Mail Address:

Organization Type: Industry

Tool ID Tool Name

General Comments

Note no tools or contact information submitted with this response. Contact did suggest operability definition and a response to a summary question.

What is your definition of system operability?

Quantified mission reliability, system availability and operations cost. (Figures of Merit, Top Level)

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Define systems to quantify top level figures of merit.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Address Information:

Mr. Marcus McElroy
Aerospace Engineer

NASA Langley Research Center/MS 248

6 East Taylor St.
Hampton VA 23681-0001

Phone Numbers:

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Organization Type: Government

Tool ID Tool Name

General Comments

No tools or operability definitions submitted. Would like copy of results.

What is your definition of system operability?

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Institute for Defense Analyses 24

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Organization Type: Industry

Tool ID	Tool Name
1044	Environmental Life cycle cost methodology

General Comments

What is your definition of system operability?

In DoD terms system operability is probably most closely related to system reliability. Refers to the systems ability to deliver the output for which it was designed. The system readiness objectives are the criteria used in assessing the ability of a system to undertake and sustain a specified set of missions at planned rates.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

The methodology we are developing will help ensure environmental considerations are factored in early on in development similar to reliability & maintainability.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

1044 Environmental Life cycle cost methodology

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? Environmental Life cycle cost methodology

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Institute for Defense Analysis for DoD

5. When was this tool developed or first used?

1996

6. What is the purpose of this tool?

To aid in the capture of significant environmental life cycle costs

7. What elements of RM&S/Operability does this tool cover?

N/A

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

9. In which phase of the acquisition life-cycle is this tool the most useful?

Concept Exploration, Demonstration/Validation, Full Scale Development, Production

10. Who owns (or controls) this tool?

IDA and Deputy Undersecretary of Defense/Environmental Security

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? No yet determined

15. Please list examples of programs, projects, systems or products that this tool has been used on.

In development now

16. Who if anyone provides user support or upgrades for this tool?

N/A

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?_

Various elements of environmental costs.

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

No special background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Methodology in development

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

Methodology will provide early consideration of environmental costs and down stream cost drives. Can be used in design process to minimize down stream costs.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes.

Overall Assessment

27

Environmental Life cycle cost methodology - As the title implies this is a methodology which is in development aimed at measuring the life cycle impacts of environmental costs. This methodology development should be followed closely for possible inclusion in the toolkit as least reference material.

Institute for Defense Analyses 25

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Organization Type: Industry

Tool ID	Tool Name
1045	Functional Cost - Estimating Relationships for Space Systems
1046	Satellite Schedule Assessment Tool

General Comments

What is your definition of system operability?

N/A

Would you like to receive the results of this survey? No

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

N/A

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

N/A

Did we ask the right questions? If not, please suggest how we might improve this survey.

N/A

1046 Satellite Schedule Assessment Tool

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? Satellite Schedule Assessment Tool

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

IDA - Bruce Harmon

5. When was this tool developed or first used?

1993

6. What is the purpose of this tool?

Assessing satellite development and production durations

7. What elements of RM&S/Operability does this tool cover?

Design, development, test, fabrication and manufacturing.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development

10. Who owns (or controls) this tool?

IDA

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Checked against historical data.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? N/A

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Defense Support Program, FEWS, Brilliant Pebbles, Space - Based Laser

16. Who if anyone provides user support or upgrades for this tool?

IDA

17. Does a database exist to support this tool? Please describe.

Yes

IDA gathered historical data

18. What specific data must be collected or available for operating this tool?_

Satellite program and weight budgets.

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

N/A

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

N/A

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Provides milestone and schedule data to be used in planning stages

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Gives detail schedule information, could be used to evaluate competing designs.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

27

Satellite Schedule Assessment Tool - This is a schedule assessment methodology aimed at assessing the milestones associated with a satellite development program. Could be useful in the pre-concept and concept exploration phases of a new space system program. Not enough information provided to make assessment on utility of including it within the envisioned toolbox.

Institute for Defense Analyses 26

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Organization Type: Industry

Tool ID	Tool Name
1047	Series Model of Missile Reliability

General Comments

What is your definition of system operability?

Assurance of operation at or above acceptable levels of reliability with sufficiently high statistical confidence.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

N/A

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

N/A

Did we ask the right questions? If not, please suggest how we might improve this survey.

N/A

1047 Series Model of Missile Reliability

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? Series Model of Missile Reliability

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Institute For Defense Analyses as a part of Missile Reliability Analysis Community

5. When was this tool developed or first used?
1984

6. What is the purpose of this tool?
Provide standard model for statistical estimation of ballistic missile reliability and aerodynamic missile reliability

7. What elements of RM&S/Operability does this tool cover?
Launch and in flight reliability of ballistic missiles, and air launched missiles.

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?
Simple spreadsheet using maximum likelihood estimates of reliability for series systems.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Full Scale Development, Operations

10. Who owns (or controls) this tool?

Generally available statistical method

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Not formally but through 1-2 decades of use by IDA, Navy and Air Force analysts.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ability to show sensitivity of statistical confidence to investment in test missiles/launchers or ground test facilities.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Evaluation of Trident I, Trident II, Minuteman II, III, Peacekeeper, ALCM, AEM reliabilities.

16. Who if anyone provides user support or upgrades for this tool?

17. Does a database exist to support this tool? Please describe.

Yes

Documented in classified Joint Staff Guidance and IDA Report IDA-S-364, Rev92D by John Santomieri, AD-C035-068, and IDA paper P-2731, by David Spalding

18. What specific data must be collected or available for operating this tool?

Subsystem failure rates appropriate to operational conditions.

Resources Questions:

1. What type of computer is required for this tool?

N/A

2. What type of operating system is required?

N/A

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

N/A N/A

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

N/A

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

N/A

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

N/A

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Other, Introductory statistics plus degree in hard science or engineering.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

N/A

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

N/A

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Proven method in multi-service environment. However, it is conservative and is not intended to extract the last bit of information from test data.

13. Can you envision this tool being applied during a “space system” development?

Yes - For test sizing and planning

14. If you can envision such a usage, how?

As a uniform method for comparing alternative test plans. Reliabilities of alternative launch rockets and quantifying benefits of subsystem tests.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

20

Series Model of Missile Reliability - This is a methodology for comparing alternative missile systems reliabilities and the subsequent sizing of test plans. Use in the pre-concept and concept exploration phases is somewhat suspect.

Institute for Defense Analyses 27

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Organization Type: Industry

Tool ID	Tool Name
1048	IDA Space Launch Processing Model

General Comments

What is your definition of system operability?

In line with the National Space Transportation Policy Common Spacelift Requirements Report, Operability includes: Customer Services to provide user friendly payload services Efficient Ground Processing Maintainability Resilience to recover from an event Responsiveness to quickly respond to changing requirements Schedule dependability Supportability.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

N/A

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

N/A

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

1048 IDA Space Launch Processing Model

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? IDA Space Launch Processing Model

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

IDA

5. When was this tool developed or first used?

1991

6. What is the purpose of this tool?

Estimation of long-term flight rate capabilities and costs for various space launch systems in order to provide a systematic basis for tradeoff analyses.

7. What elements of RM&S/Operability does this tool cover?

Operations/Scheduling

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Operations, Modification

10. Who owns (or controls) this tool?

IDA

11. Is it available for others to use?

Yes, with caveats

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they?

The model is an internal IDA tool and not designed for public use or support.

However, the model is small and should be reasonably easy for some to use and now support should be needed. IDA could possibly run the model for a government task and modify it to the task if funded.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results.

Informally validated against Space Shuttle operations capability

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Long term schedule accuracy, simplicity of operation.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Analysis of achievable STS flight-rate for NASA. Analysis of mixed ELV and STS Fleet Service of Space Station for NASA.

16. Who if anyone provides user support or upgrades for this tool?

IDA

17. Does a database exist to support this tool? Please describe.

Yes

Historical data on time required for each phase of STS processing plus expected unforeseen delays at each phase is documented in IDA Paper P-2806 " Space Shuttle facilities and processing constraints" , ELV processing timelines documented in informal IDA briefing.

18. What specific data must be collected or available for operating this tool?

The number of specific facilities/processes involved in vehicle processing, their relationship to each other, and historical data on

both planned and unplanned times required in each process step, system catastrophic failure rate, costs, replenishment strategy.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes Text editor that can read and save files in ASCII format

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

501 - 1000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

641 - 1000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy.

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The tool has been helpful in estimating the impact of various system design or modification choices on the overall capability and cost of a launch system. It is effective as a first-cut/screening process for a large number of options.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

The model could provide a relative estimate of the effects of various combinations of facilities/processes on the expected flight rate capability. The effects of vehicle reliability, replenishment acquisition strategies vs fleet size, etc. could be estimated.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

52

IDA Space Launch Processing Model - Definitely a tool worthy of further investigation for the RM&S/O toolbox. Low cost, easy to use, available, with supporting data to support the analysis of operations processing.

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Organization Type: Industry

Tool ID	Tool Name
1049	Hardware in the Loop (HWIL) Testbeds

General Comments

What is your definition of system operability?

Operability = Effectiveness + Suitability in realistic field conditions. Effectiveness measures how well the system performs against its design requirements. Suitability measures how well the operator can use the system for its intended purpose. This includes RM&A plus all of the related "ilities".

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Emulate field conditions using actual operators as much as possible during the development cycle. This implies that development tests (DT) should be done in a setting as close as possible to an operational test (OT).

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Contact Nat Sojourner at the National Test Facility (NTF) in Falcon AFB, Colorado (719) 567-9310

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

1049 Hardware in the Loop (HWIL) Testbeds

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? Hardware in the Loop (HWIL) Testbeds

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Arnold Engineering Development Center (AEDC) Tullahoma TN (Bob Smith) National Test Facility (NTF), Falcon AFB, CO (Nat Sajourner)

5. When was this tool developed or first used?
1987

6. What is the purpose of this tool?
To incorporate flight hardware / software in a system - level test under man in the loop control before placing it in orbit.

7. What elements of RM&S/Operability does this tool cover?
Man-Machine Interface, concept of operations (CONOPS), System effectiveness.

8. If this tool is not a model, does it support a model? Yes If so what is the name of that model?
Various models are used to support HWIL Testbeds. The synthetic scene generation model (SSGM), developed at the National Research Laboratory (NRL) is one of the main ones.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Demonstration/Validation, Full Scale Development, Operations

10. Who owns (or controls) this tool?

AEDC, NTF, and NRL

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Contractual and/or user agreements with each of the agencies/facilities involved.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. AEDC's test chambers have been validated against NIST standards. SSGM has been validated against phenomenology data bases, although the underlying data bases still require additional validation

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? The level of risk mitigation as compared with the alternative of testing after placing the spacecraft in orbit.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Defense Initiative; Boost Phase Surveillance and Tracking System (BSTS); Follow-on Early Warning System (FEWS)

16. Who if anyone provides user support or upgrades for this tool?

NRL, AEDC, and NTF

17. Does a database exist to support this tool? Please describe.

Yes

Various phenomenology data bases exist; contact any of the three agencies for details.

18. What specific data must be collected or available for operating this tool?_

Earth and target irradiance values in infrared visible or ultraviolet bands.

Resources Questions:

1. What type of computer is required for this tool?

Workstation

2. What type of operating system is required?

Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

40000kb +

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

8001 - 16000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

\$50000+ per copy

10. What is the approximate annual cost of user support?

N/A

11. What is the approximate delivery time for this tool once requested by NASA?

30+ days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The military space community has only recently become interested in system level HWIL testing with man-in-loop interaction. This approach is expected to mitigate the risks involved with new sensor spacecraft, which have traditionally been placed in orbit using a "best guess" approach for the engineering design.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

See above

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

41

Hardware in the Loop (HWIL) Testbeds - More appropriate to later phases of development than the pre-concept and concept exploration phases. Not a Windows based tool. Relative high costs. Not appropriate for RM&S/O toolbox.

Industrial Analysis Support Office29

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Organization Type: Government

Tool ID	Tool Name
1050	Decision Support Information System

General Comments

What is your definition of system operability?

Do not know enough about RM&S to comment

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Would like to participate on the committee developing the system

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

NASA POC is listed on this survey. In addition: IASO POC is Donna Butler (215) 737-5323

Did we ask the right questions? If not, please suggest how we might improve this survey.

Industrial Analysis Support Office 29

1050 Decision Support Information System

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, Information System

2. What is the name of this tool? Decision Support Information System

3. Is it identified by other names? Yes

If yes, please specify:
DSIS

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Industrial Analysis Support Office (IASO)

5. When was this tool developed or first used?
1994

6. What is the purpose of this tool?
To collect, validate and analyze defense contractor data for the determination of industrial capability.

7. What elements of RM&S/Operability does this tool cover?
N/A

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?
Concept Exploration

10. Who owns (or controls) this tool?

Industrial Analysis Support Office29

Industrial Analysis Support Office

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Data is considered business sensitive and proprietary

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Customer Feedback

15. Please list examples of programs, projects, systems or products that this tool has been used on.

OSD's Space Launch Ind. Cap. Study. EELV study (Evolved Expendable Launch Vehicle) with IDA.

16. Who if anyone provides user support or upgrades for this tool?

IASO

17. Does a database exist to support this tool? Please describe.

Yes

Informix relational database - converting to Oracle database with graphical user interface (GUI).

18. What specific data must be collected or available for operating this tool?_

Telnet address, User Login.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Industrial Analysis Support Office 29

Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

None

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

No special background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Industrial Analysis Support Office29

Customer feedback has been favorable. We have been able to provide online information to customers which would have required months to acquire.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Contractor risk assessments as applicable. Contractor capabilities and past performance.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

60

Decision Support Information System - Not applicable to the RM&S/O toolbox. Provides no capability in RM&S analysis areas.

Veda Inc. 30

Address Information:

Mr. Daniel Heimerdinger
Director, Civil, Military, & Commercial Space

Veda Inc.

1800 N. Beauregard St.
AlexandriaVA22311

Phone Numbers:

Work(703) 845-7363
Fax (703) 845-7142

E-Mail Address: dheimerding.wash@veda.com

Organization Type: Industry

Tool ID	Tool Name
1051	LCASEMM
1052	A/N CASEMM

General Comments

What is your definition of system operability?
Domain of applicability of the model/simulation

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.
Make sure a VV&A (Validation, Verification & Accreditation) plan is proposed & followed even if accreditation is not ultimately sought. This is integratl to software Q&A.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Veda Inc. 30

Did we ask the right questions? If not, please suggest how we might improve this survey.

1) Should ask for summary literature 2) Should ask if system is COTS or service 3) Should have user references 4) Should ask if demo's are available.

1051 LCASEMM

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation, A Simulation that performs top-down object oriented process simulation & bottoms-up cost estimating.

2. What is the name of this tool? LCASEMM

3. Is it identified by other names? Yes

If yes, please specify:

Launch System Processing Computer Aided Systems Engineering and Management Model

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Veda, Inc.

5. When was this tool developed or first used?

1987

6. What is the purpose of this tool?

Model & cost the launch system process including vehicle component logistics, assembly, and infrastructure operations subject to various mission manifest models. A major focus is on process risk & ops choke points.

7. What elements of RM&S/Operability does this tool cover?

Launch system process domain using object-oriented knowledge-based core architectures.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Operations, Modification

10. Who owns (or controls) this tool?

Veda, Inc.

11. Is it available for others to use?

Depends on who the user is.

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? License restrictions/proprietary data if modified for a commercial entity.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Currently performing a function decomposition of the code and a validation against Space Shuttle and Delta Launch System processes

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ease of use. Analysis flexibility (through a fully integrated analysis environment) cost, ability to simulate different system by the user without code modification.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

ALS, Titan, STS

16. Who if anyone provides user support or upgrades for this tool?

Veda

17. Does a database exist to support this tool? Please describe.

Yes

Veda has provided several options including a proprietary LCASEMM database, Microsoft Excel, and Oracle (under development).

18. What specific data must be collected or available for operating this tool?_

Vehicle and process data, cost estimating factors, manifest/traffic demand.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows, McIntosh, Unix, Open architecture (except for user interface)

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

None

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

8001 - 16000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required, Other Experience in launch system "lingo" is necessary

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy limited distribution, \$50000+ unlimited distribution

10. What is the approximate annual cost of user support?

\$10000+ per copy for all sites

11. What is the approximate delivery time for this tool once requested by NASA?

30+ days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Enhanced process visualization. Direct interface to Microsoft Excel, Powerpoint, and Word for rapid presentation/documentation export. The only known fully integrated launch system process & cost model. Easy to use. Ideal for concept analysis and identification of choke points & risks.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

Implement a launch system process architecture & traffic model along with a vehicle family & assess its capabilities/shortfalls/cost. To validate program requirements. To modify program requirements. Evaluate contractor proposals.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

60

LCASEMM - A derivative of the Advanced Launch System System Model (ALSYM). Successfully used to build program cost estimates and evaluate launch system concepts. Multi platform use makes this an attractive tool for inclusion in the toolbox

1052 A/N CASEMM

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? A/N CASEMM

3. Is it identified by other names? Yes

If yes, please specify:

Air Force / NASA TT&C Network computer aided system engineering and management model.

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Veda Inc

5. When was this tool developed or first used?

1992

6. What is the purpose of this tool?

General satellite TT&C network architecture, capability, and cost analysis.

7. What elements of RM&S/Operability does this tool cover?

Domain using object-oriented knowledge based core architecture.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Operations, Modification

10. Who owns (or controls) this tool?

Veda

11. Is it available for others to use?

Yes, Depends on who the user is.

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? License

restrictions/proprietary data if modified for a commercial entity.

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

About to Start. Using Functional process decomposition & comparison of actual AFSCN Network data & schedules to system output

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ease of use

use

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Air Force Satellite Control Network, NASA Code 501 Planning
Lockheed Martin Network Analysis

16. Who if anyone provides user support or upgrades for this tool?

Veda

17. Does a database exist to support this tool? Please describe.

Yes

Proprietary or Excel or Oracle (under development)

18. What specific data must be collected or available for operating this tool?

TT&C Network structure (Control node & tracking sites - ground & space - based) Sats under support, orbits & TT&C requirements, communications, maintenance & stabilizing requirements.

Resources Questions:

Veda Inc. 30

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

None

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

16000 - 32000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required, Need Sat TT&C experience / understanding

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

\$10000+ per copy

11. What is the approximate delivery time for this tool once requested by NASA?

Veda Inc. 30

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Extremely useful for network/mission design, analysis & costing.
Very useful for assessing opportunities & capabilities for using other people's networks. Helpful at assessing costs for use (e.g. Fees)

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

All phases

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment 57

Innovative Timely Solutions 3 1

Address Information:

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Phone Numbers:

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Organization Type: Industry

Tool ID	Tool Name
1053	RKP232 Static and Dynamic System Model
1054	RKP572 Reliability Performance Prediction Mil-HNDBK-217/Bell Core
1055	RKP648 Failure Mode, Effect, and Criticality Analysis
1056	RKP293 Reliability Skill Tool Set
1057	RKP606 Fault Tree Analysis

General Comments

What is your definition of system operability?

Is the system ready to perform or already performing its intended function/mission.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

N/A

Innovative Timely Solutions 31

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

N/A

Did we ask the right questions? If not, please suggest how we might improve this survey.

N/A

Innovative Timely Solutions 3 1

1053 RKP232 Static and Dynamic System Model

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, It is a computer aided engineering tool (CAE). It combines series and parallel reliability entities into a system. This system is then analyzed. It combines aspects of model, process, simulation and practice.

2. What is the name of this tool? RKP232 Static and Dynamic System Model

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Innovative Timely Solutions (ITS)

5. When was this tool developed or first used?

1991

6. What is the purpose of this tool?

To analyze static and dynamic reliabilities of systems.

7. What elements of RM&S/Operability does this tool cover?

Reliability analysis of simple to complex systems.

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

It is a CAD tool which combines series, parallel, and Poisson Exponential Distribution.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Innovative Timely Solutions 3 1

Pre-Concept, Concept Exploration, Demonstration/Validation, Modification

10. Who owns (or controls) this tool?

ITS

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Validation to Mil-HDBK-338/Mil-Std-756

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Reliability prediction number correctness, ease of use.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Avionics, communication equipment design.

16. Who if anyone provides user support or upgrades for this tool?

ITS

17. Does a database exist to support this tool? Please describe.

No

None is required. The user builds the database as the system is graphically described.

18. What specific data must be collected or available for operating this tool?

A block diagram of the design is the normal starting point. However, it can be employed as soon as the design partitioning begins.

Resources Questions:

1. What type of computer is required for this tool?

Innovative Timely Solutions 3 1

Personal

2. What type of operating system is required?

Windows, Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

1001 - 2000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

Innovative Timely Solutions 3 1

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This is an easy to use tool for modeling simple to complex systems.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

If you are interested in a reliability analysis of simple to complex systems. One might be interested in determining the reliability of a redundant (backup) set of components.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

57

RKP232 Static and Dynamic System Model - Windows based tool for analyzing the reliability of complex systems. Apparently can be used with various levels of system detail. Its' relative low cost and applicability during the pre-concept phases makes it worthy of further consideration for the RM&S/O toolbox.

Innovative Timely Solutions 3 1

1054 RKP572 Reliability Performance Prediction Mil-HDBK-217/Bell Core

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, It is a computer aided engineering tool (CAE). It combines series and parallel reliability entities into a system. This system is then analyzed. It combines aspects of model, process, simulation and practice.

2. What is the name of this tool? RKP572 Reliability Performance Prediction Mil-HDBK-217/Bell Core

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Innovative Timely Solutions (ITS)

5. When was this tool developed or first used?
1990

6. What is the purpose of this tool?
This tool calculates the constant failure rate of a system given the Mil-HDBK-217 or BellCore prediction rules for components. It also has a facility for computing the infant mortality for a given time period. It also offers a feature for reliability allocations to a systems' components given a reliability goal.

7. What elements of RM&S/Operability does this tool cover?
Reliability analysis of systems by parts count or parts stress.

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

Innovative Timely Solutions 3 1

It is a CAD tool which allows the user to employ Mil-HDBK-217 and/or Bellcore to determine the system level failure rate. The Weibul Distribution and the Complete Response model are employed to determine infant mortality failure rates.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Modification

10. Who owns (or controls) this tool?

ITS

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Validation to Mil-HDBK-217F Notice and BellCore publications.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Failure rate/reliability prediction number correctness, ease of use.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Avionics, communication equipment design.

16. Who if anyone provides user support or upgrades for this tool?

ITS

17. Does a database exist to support this tool? Please describe.

Yes

A master failure rate file is provided to assist the user in the development of initial failure rate predictions.

Innovative Timely Solutions 3 1

18. What specific data must be collected or available for operating this tool?_

A bill of materials should be on-hand to start the analysis. The program has a facility for "reading" user provided bill of materials in ASCII format.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows, Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

1001 - 2000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Logistician background required, Design Engineer background required.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

Innovative Timely Solutions 3 1

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This is an easy to use tool for performing a top-down reliability analysis systems.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

If you are interested in a component or system reliability prediction. Estimating the failure rate or reliability of a particular entity or of its components.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

6 1

RKP572 Reliability Performance Prediction Mil-HDBK-217/Bell Core - Windows & DOS based tool for analyzing the reliability of a system and its components. Requires bill of material type data on system components to perform analysis. Its' low cost and has potential applicability during the pre-concept phases of some space system programs. Should be investigated further, especially as more programs are using COTS hardware items.

Innovative Timely Solutions 3 1

1055 RKP648 Failure Mode, Effect, and Criticality Analysis.

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, It is a computer aided engineering tool (CAE). It combines series and parallel reliability entities into a system. This system is then analyzed. It combines aspects of model, process, simulation and practice.

2. What is the name of this tool? RKP648 Failure Mode, Effect, and Criticality Analysis.

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Innovative Timely Solutions (ITS)

5. When was this tool developed or first used?

1990

6. What is the purpose of this tool?

This tool supports failure mode, effect and criticality analysis in accordance with Mil-STD-1629. The analysis engine allows the user to perform zonal analysis, failure effects analysis, and damage analysis.

7. What elements of RM&S/Operability does this tool cover?

It provides a tool for the detail analysis of a component, its possible failure modes, possible failure mechanisms, and impacts on surroundings and system.

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

Innovative Timely Solutions 3 1

It is a CAD tool which provides the user with a friendly tabular format for performing a detailed analysis.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept Concept Exploration, Demonstration/Validation, Full Scale Development, Modification

10. Who owns (or controls) this tool?

ITS

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Validation to Mil-STD-1629.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? This tool provides an easy to use/understand method for documenting component level details and their impact on the system.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Avionics equipment design.

16. Who if anyone provides user support or upgrades for this tool?

ITS

17. Does a database exist to support this tool? Please describe.

No

None is required

18. What specific data must be collected or available for operating this tool?_

Innovative Timely Solutions 3 1

A block diagram of the design or bill of materials is the normal starting point. However, it can be employed as soon as the design partitioning begins.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows, Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

1001 - 2000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

Innovative Timely Solutions 3 1

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This is an easy to use tool for investigating components, their failure potential, and the impact on various levels of the system.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

If you are interested in performing a detailed bottom-up reliability study of a system.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

57

RKP648 Failure Mode, Effect, and Criticality Analysis. - Windows & DOS based tool for performing Failure Modes Effects and Criticality analysis on a system and its components. Requires either block diagram or bill of material type data on system and components to perform analysis. Low cost and applicability during the pre-concept phases makes this a tool that should be investigated further.

Innovative Timely Solutions 3 1

1056 RKP293 Reliability Skill Tool set

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, It is a computer aided engineering tool (CAE). It combines series and parallel reliability entities into a system. This system is then analyzed. It combines aspects of model, process, simulation and practice.

2. What is the name of this tool? RKP293 Reliability Skill Tool set

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Innovative Timely Solutions (ITS)

5. When was this tool developed or first used?
1988

6. What is the purpose of this tool?
This tool set provides a number of items for performing reliability and maintainability tasks. The task covered include Weibul test analysis, Duane model reliability growth analysis, thermo budgeting, cost of ownership, process yield/failure rate forecasting, warranty cost planning and several sample and test planning tools

7. What elements of RM&S/Operability does this tool cover?

This tool set supports sample planning, test planning, design trade-off studies, warranty cost simulation, spare forecasting, and acceleration factor determinations.

Innovative Timely Solutions 3 1

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

It is a CAD tool which combines a large variety of models such as Exponential Distribution, Weibull Distribution, Duane reliability growth model, Arrhenius equation, Chi square test analysis, Poisson Distribution, Binomial Distribution, contingency test tables, cost of ownership models, Monte Carlo simulation, and regression analysis.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operations, Modification, Disposal

10. Who owns (or controls) this tool?

ITS

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Validation to Mil-HDBK-338, Reliability in Engineering Design by Kapur and Lamberson.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ease of use and the correctness of numbers derived from the various analysis methods.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Medical, automotive, avionics and communication equipment design.

16. Who if anyone provides user support or upgrades for this tool?

ITS

17. Does a database exist to support this tool? Please describe.

No

Innovative Timely Solutions 3 1

None is required

18. What specific data must be collected or available for operating this tool?_

The requirements vary amongst the tools in the tool set. A demonstration sample is available which display the various input requirements and expected outputs.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows, Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

501 - 1000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Logistician background required, Design Engineer background required, General college or academic background required.

Innovative Timely Solutions 3 1

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This is an easy to use tool for solving typical reliability engineering problems.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

If you are interested in solving typical, routine reliability problems. One might be interested in determining the number of additional test hours need to be observed without additional failure to declare a test a success.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

57

RKP293 Reliability Skill Tool set - Windows & DOS based tool for performing reliability analysis tasks on a system and its components. Requires either block diagram or bill of material type data on system and components to perform analysis. Low cost and applicability during the pre-concept phases makes this a tool that should be investigated further.

Innovative Timely Solutions 3 1

1057 RKP606 Fault Tree Analysis

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, It is a computer aided engineering tool (CAE). It combines "AND" and "OR" gates with events to create a top down representation of a system. With this representation the propagation of failures can be studied.

2. What is the name of this tool? RKP606 Fault Tree Analysis

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)
Innovative Timely Solutions (ITS)

5. When was this tool developed or first used?
1991

6. What is the purpose of this tool?
To analyze failure propagation within reliability systems.

7. What elements of RM&S/Operability does this tool cover?
Reliability analysis of simple to complex systems.

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

It is a CAD tool which employs a set of rules for determining how failures propagate within a system. It also determines critical paths and the resulting probabilities.

Innovative Timely Solutions 3 1

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development

10. Who owns (or controls) this tool?

ITS

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Validation to Mil-HDBK-338 Fault Tree Analysis Guide from RADC.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? The failure propagation paths, ease of use.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Electronic and communication equipment design.

16. Who if anyone provides user support or upgrades for this tool?

ITS

17. Does a database exist to support this tool? Please describe.

No

None is required. The user builds the database as the system is graphically described.

18. What specific data must be collected or available for operating this tool?_

A block diagram of the design is the normal starting point. However, it can be employed as soon as the design partitioning begins.

Innovative Timely Solutions 3 1

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows, Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2001 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

1001 - 2000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Very Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

Innovative Timely Solutions 3 1

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

This is an easy to use tool for modeling simple to complex systems.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

If you are interested in a reliability analysis of simple to complex systems. One might be interested in determining the paths that a failure would have to travel to cause a system failure.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

57

RKP606 Fault Tree Analysis- Windows & DOS based tool for performing fault tree analysis tasks on a system and its components. Requires either block diagram or system partitioning data on system perform analysis. Low cost and applicability during the pre-concept phases makes this a tool that should be investigated further.

Address Information:

Mr. Keith Janasak
Support Engineer Automation Strategy MGR.

Texas Instruments Systems Group

8330 LBJ Freeway, MS 8313
DallasTX

Phone Numbers:

Work(214) 997-5977
Fax (214) 997-3674

E-Mail Address: kjanasak@ti.com

Organization Type: Industry

Tool ID	Tool Name
1058	CARMA

General Comments

What is your definition of system operability?

Successful accomplishment of desired task using a system depends on: Equipment reliability, maintainability, testability, and supportability, coupled with reliable user performance (the total man machine system)

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Could probe into whether one quantitatively assess the "useability" of the system

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Chris Leak - Mission Environmental Requirements Integration
Technology (MERIT) Program Manager, Wright Labs (513) 235-3021
or (513) 235-1633 Fax or leakce.wlfir@fivmailgw.flight.wpafb.af.mil

**Did we ask the right questions? If not, please suggest how
we might improve this survey.**

1058 CARMA

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, R&M CAE Toolkit

2. What is the name of this tool? CARMA

3. Is it identified by other names? Yes

If yes, please specify:

Computer Aided Reliability & Maintainability Applications Toolkit.

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Texas Instruments

5. When was this tool developed or first used?

1990

6. What is the purpose of this tool?

Provide R&M engineers with a cost effective set of integrated CAE tools that facilitate real time design impacting analyses, verification, and decision support tasks.

7. What elements of RM&S/Operability does this tool cover?

Reliability: Allocations, predictions, modeling, thermal analysis, vibration analysis, derating analysis, growth testing, FMECA;
Maintainability: Predictions, RCM, Test/Bit coverage, testability 2165 checklist, hazard analysis; LSAR 1388 2A/2B Export

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

Operational predictions 217c through FN2, Bellcore, Non-operational predictions TR-85-91

9. In which phase of the acquisition life-cycle is this tool the most useful?

Demonstration/Validation, Full Scale Development

10. Who owns (or controls) this tool?

Texas Instruments

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Licenses must be purchased

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Board analysis trails that incorporate physics of failure tools from the University of Maryland have been validated by UMD using industry data and laboratory analysis results. TI developed tools have been verified through program use.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Cycle time improvement in R&M tasks and related productivity improvements.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

RADAR, Electro-optics, and missile programs such as (F22 RADAR, F18 FLIR, JSOW, JAVELIN, PAVEWAY, etc.); commercial programs such as Digital micro-mirror devices (DMD) and local multi-point distribution system.

16. Who if anyone provides user support or upgrades for this tool?

Texas Instruments provides user support and product upgrades.

17. Does a database exist to support this tool? Please describe.

Yes

CARMA toolkit include the CALCE Materials database, central database, FMECA database, and a maintainability database.

18. What specific data must be collected or available for operating this tool?

Parts lists, board geometry, product hierarchy

Resources Questions:

1. What type of computer is required for this tool?

Personal, 486 or better

2. What type of operating system is required?

Windows, Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

40000kb+

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

\$50000+ per copy, Min 3 seats

10. What is the approximate annual cost of user support?

5001 - \$10000 per copy, Min 3 seats

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Prime-subcontractor teams have realized productivity and cycle time improvements by sharing databases rather than paper reports. Individual R&M task improvements vary by user, but have been reported to be 15% - 50%.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

The basic R&M process methodology for space system development parallels that of the defense products. CARMA tools can support many of the same tasks that promote effective R&M participation within an integrated product development team environment.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

49

CARMA - A Windows based tool aimed and R&M engineers in the electrical/electronics areas. Extensive database of parts and materials provided. Targeted at later phases of program development. Costs and target audience probably makes this tool inappropriate for the RM&S/O toolbox.

NASA MSFC/PD 34 33

Address Information:

Mr. Richard Brown

NASA MSFC/PD 34

Marshall Space Flight Center
HuntsvilleAL35812

Phone Numbers:

E-Mail Address:

Organization Type: Government

Tool ID	Tool Name
1059	Performance Risk
1060	Launch Vehicle Ascent Simulation
1061	FEAT - Failure Environment Analysis Tool

General Comments

What is your definition of system operability?

The ability of a system to operate effectively and efficiency

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

None

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

No

Did we ask the right questions? If not, please suggest how we might improve this survey.

Yes

1059 Performance Risk

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? Performance Risk

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Richard W. Brown, NASA/MSFC/PD34

5. When was this tool developed or first used?

1994

6. What is the purpose of this tool?

The tool models the development cycle of a new launch vehicle and its components to determine likely performance at project completion.

7. What elements of RM&S/Operability does this tool cover?

Supports operability analysis by estimating the probability of missing performance goal.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development

10. Who owns (or controls) this tool?

NASA/MSFC/PD34

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? The tool itself is unconstrained. But when the model is modified to model a specific vehicle it is restricted to reflect the restrictions on that vehicle design.

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

Although its use on the hypersonic reusable booster (HSRB) closely followed the results of the X-34.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? That is hard to say since the application appears to be unique at this stage.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Tool has been used on HRSB, RLV In-house studies, and Lockheed Martin X-33 proposal.

16. Who if anyone provides user support or upgrades for this tool?

Not a distributed product, so not a problem

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

Require data on Isp and weight including normal values, distribution parameters for variation.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes Requires Microsoft Visual Basic V3.0 or higher

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy (no cost)

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The performance risk tool has two benefits. First it assists in setting initial performance goals that are realistic to the development process and level of technology. Second, by continuously updating parameter variability to reflect program progress, it can be used to measure the program progress toward performance goals.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

The performance risk tool has two benefits. First it assists in setting initial performance goals that are realistic to the development process and level of technology. Second, by continuously updating parameter variability to reflect program progress, it can be used to measure the program progress toward performance goals

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

50

Performance Risk - Windows based tool that is easy to use. Applicability outside of launch vehicles is somewhat questionable because of the lack of detail provided on the tool. Follow-up is recommended. If tool could be generalized to "space systems" then it might be applicable to the RM&S toolbox.

1060 Launch Vehicle Ascent Simulation

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? Launch Vehicle Ascent Simulation

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Richard W. Brown, NASA/MSFC/PD34

5. When was this tool developed or first used?
1988

6. What is the purpose of this tool?

Analyzes launch vehicle ascent reliability (powered flight) to input to mission reliability, vehicle recovering (if applicable), and passenger/crew survivability (if applicable).

7. What elements of RM&S/Operability does this tool cover?

Considers the impact of system reliability on operability.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

NASA/MSFC/PD34

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? The tool itself is unconstrained. But when the model is modified to model a specific vehicle it is restricted to reflect the restrictions on that vehicle design.

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

Original model of shuttle was validated against shuttle results. Unfortunately because the model is modified for each vehicle considered, verification could be a continuous process.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None. We costumed designed it because nothing else was available.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Shuttle, Shuttle-C, In-house RLV, Lockheed Martin RLV

16. Who if anyone provides user support or upgrades for this tool?

Not a distributed product, so not a problem

17. Does a database exist to support this tool? Please describe.

No

Not per se. But a matrix of trajectory data is required.

18. What specific data must be collected or available for operating this tool?

Trajectory data and system reliability data.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes Requires Microsoft Visual Basic V3.0 or higher

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy (no cost)

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The program estimates launch reliability (including aborts, where applicable). This provides an estimate of mission reliability and the contribution modeled systems to mission reliability.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

The program estimates launch reliability (including aborts, where applicable). This provides an estimate of mission reliability and the contribution modeled systems to mission reliability.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

50

Launch Vehicle Ascent Simulation- Windows based tool that is easy to use. Applicability outside of launch vehicles is somewhat questionable. Follow-up is recommended to determine if tool could be generalized to other "space systems" reliabilities. If not might be useful to include because of the amount of launch vehicle analysis done at MSFC.

1061 FEAT - Failure Environment Analysis Tool

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? FEAT - Failure Environment Analysis Tool

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Originally by NASA/JSC, but refined to current form by NASA/MSFC/EP

5. When was this tool developed or first used?
1990

6. What is the purpose of this tool?

FEAT allows user to model a physical system and see the propagation of failure with the system and how it effects other systems.

7. What elements of RM&S/Operability does this tool cover?

Reliability analysis of a system and operations

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

MSFC/EP

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they? .

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

In Process. Expected with one month of B version

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Usefulness of program to engineering design.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

SSME, NLS, HLLV Modeling, Phase 1 X-33

16. Who if anyone provides user support or upgrades for this tool?

MSFC/EP

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?_

System and subsystem component data, reliabilities, failure rates.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

4001 - 8000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy (no cost)

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Does an excellent job of showing failure propagation paths. With addition of reliability module it now can calculate probabilities. It is

a very useful product for demonstrating the impacts of reliability on system's design.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

Does an excellent job of showing failure propagation paths. With addition of reliability module it now can calculate probabilities. It is a very useful product for demonstrating the impacts of reliability on system's design

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

45

Failure Environment Analysis Tool (FEAT) - McIntosh based tool that is easy to use. Appears to be a limited Failure Modes and Effects tool. Cost and availability as an in-house tool makes it attractive for inclusion to the toolbox. Follow-up is recommended.

NASA MSFC/PD 34 34

Address Information:

Mr. Jeff Morton

NASA MSFC/PD 34

Marshall Space Flight Center
HuntsvilleAL35812

Phone Numbers:

Please contact Mike Nix (PS03)at MSFC, (205)544-7877 for information.

E-Mail Address:

Organization Type: Government

Tool ID	Tool Name
1062	Launch Statistics Database

General Comments

Database is intended for internal use only. It is not regularly maintained/updated and some information is not official. It is not recommended for use by other organizations.

What is your definition of system operability?

Operability defintion or summary question answers not provided.

Would you like to receive the results of this survey?

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

NASA MSFC/PD 34 35

Address Information:

Mr. David Lanier

NASA MSFC/PD 34

Marshall Space Flight Center
HuntsvilleAL35812

Phone Numbers:

E-Mail Address:

Organization Type: Government

Tool ID	Tool Name
1063	PARATSS
1064	STAFFSS
1065	ESDOTS
1066	SLAM II

General Comments

What is your definition of system operability?

The infrastructure, resources, and conceptual operations framework that defines the operational effectiveness of a system design. Effectiveness refers to the systems operational characteristics that drive low life cycle costs (LCC) and increase vehicle reliability and operations safety.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

None

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

No

Did we ask the right questions? If not, please suggest how we might improve this survey.

1063 PARATSS

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? PARATSS

3. Is it identified by other names? Yes

If yes, please specify:

Parametric Analysis and Reliability Assessment Tool for Staged Systems

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

NASA, Marshall Space Flight Center, Operations Analysis Branch, David Lanier

5. When was this tool developed or first used?

1993

6. What is the purpose of this tool?

To provide "same-basis" reliability estimates for multiple staged vehicles based on historical averages to allow configuration (launch vehicle) comparisons using configuration drivers.

7. What elements of RM&S/Operability does this tool cover?

This Excel spreadsheet allows the operability engineer to do configuration trades that minimize the number or types of major systems (strategic level) that contribute to the unreliability of a multi-stage vehicle or space system.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

NASA, Marshall Space Flight Center, Operations Analysis Branch,
David Lanier

11. Is it available for others to use?

No

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? The original spreadsheet developed in Excel 4.0 format was lost 2 years ago in a hard disk crash. There was no back up that I've found yet. Paper copies of the model exist & can be rebuilt if required in the future.

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? None exist that I'm aware of.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Access to Space Study.

16. Who if anyone provides user support or upgrades for this tool?

David Lanier / PD31

17. Does a database exist to support this tool? Please describe.

Yes

Space Launch Reliability Growth developed by Sparta Inc.

18. What specific data must be collected or available for operating this tool?

Configuration data for launch vehicle definition.

Resources Questions:

1. What type of computer is required for this tool?

Personal, PC running MS Windows 3.1 or higher., Application used is Excel v4.0 or higher.

2. What type of operating system is required?

Windows, Should work on McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes MS Excel 4.0 or greater

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

4001 - 8000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

It provides an effective means of doing a comparative evaluation at differing vehicles reliability sensitivities to vary configuration changes.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

See Access to Space Study.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

52

Parametric Analysis and Reliability Assessment Tool for Staged Systems (PARATSS) - Windows based Excel spreadsheet to analyze launch vehicle reliabilities of staged systems. Probably to specific to launch vehicle systems and the question under consideration to be included in a general RM&S toolbox for space systems.

1064 STAFFSS

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, Analysis Software

2. What is the name of this tool? STAFFSS

3. Is it identified by other names? Yes

If yes, please specify:

Space Transportation Architecture Fleet & Facility Sizing Software.

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

NASA, Marshall Space Flight Center, Operations Analysis Branch,
David Lanier

5. When was this tool developed or first used?

1986

6. What is the purpose of this tool?

It was used as a tool to provide quick turnaround fleet & facility sizing estimates derived from GROPE (Ground Resources Operations Program Executive) outputs. It used a new algorithm that was later enhanced and is part of ESDOTS

7. What elements of RM&S/Operability does this tool cover?

Performs fleet & facility sizing. Requires manual input of size and relative times for ground resources.

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration

10. Who owns (or controls) this tool?

NASA, Marshall Space Flight Center, Operations Analysis Branch,
David Lanier

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? It is written in GW Basic & ported to QuickBasic on the IBM PC. Runs in MSDOS mode. It is no longer used in-house in lieu of ESDOTS and is no longer maintained. It has been used to validate ESDOTS output

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. ESDOTS and STAFFSS validate each other & STAFFSS was validated against GROPE outputs

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Ease of Use & turnaround. Flow building capabilities.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Transportation Architecture Studies & RLV

16. Who if anyone provides user support or upgrades for this tool?

David Lanier (It is longer supported)

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

Ground flow concept definition, knowledge of resources required, and manual critical path calculation for seize & release time data inputs.

Resources Questions:

1. What type of computer is required for this tool?

Personal, IBM PC Compatible 80286 or greater, MS QuickBasic Compiler

2. What type of operating system is required?

Other MS DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes MS QuickBasic v4.5

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

501 - 1000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Difficult

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Logistician background required, Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Allows us to verify other tools.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

To support resource requirements studies.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

34

Space Transportation Architecture Fleet & Facility Sizing Software (STAFFSS) - MS DOS basic program that is used to perform facilities and resource requirements studies. No longer supported. Probably too specific to launch vehicle systems to be included in a general RM&S toolbox for no launch vehicle space systems.

1065 ESDOTS

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other, Decision Support Environment.

2. What is the name of this tool? ESDOTS

3. Is it identified by other names? Yes

If yes, please specify:

Expert System for Design, Operations, Technology Studies.

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

NASA, Marshall Space Flight Center, Operations Analysis Branch,
David Lanier

5. When was this tool developed or first used?

1990

6. What is the purpose of this tool?

Performs fleet & facility sizing analysis using launch vehicle or generic space transportation ground flows. Can do what if scenarios by changing technologies, resources, & work shifts used in processing a flow.

7. What elements of RM&S/Operability does this tool cover?

Tool is used to identify resource bottlenecks in the operations processing design which can be used to guide the analyst in applying or changing the operability driven characteristics of a scenario to drive toward a minimized life cycle cost operations concept.

8. If this tool is not a model, does it support a model? No
If so what is the name of that model?

Uses critical path calculations applied to an in-house developed algorithm for spreading and minimizing shared resource contention.

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Operations, Modification

10. Who owns (or controls) this tool?

NASA, Marshall Space Flight Center, Operations Analysis Branch, David Lanier

11. Is it available for others to use?

Yes, But still undergoing development at a low level

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Since all functionality has not been implemented and (the latest version is complete rewrite from ground up of Martin delivered code) it still undergoing development, PD34 does not have manpower to provide other users with technical support.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Verified results against a simulation program called STAFFSS (in-house tool)

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? Compare the time to do an analysis using GROPE or STAFFSS to ESDOTS requirements.

15. Please list examples of programs, projects, systems or products that this tool has been used on.
NLS & RLV

16. Who if anyone provides user support or upgrades for this tool?
CSC Program development support contractor

17. Does a database exist to support this tool? Please describe.
Yes

A database of launch flows objects and resource objects are kept to provide starting points for new scenario development and analysis.

18. What specific data must be collected or available for operating this tool?

An operations functional flow and task descriptions for activities in that flow. Flow resource requirements and flow inter dependencies must be understood.

Resources Questions:

1. What type of computer is required for this tool?

Workstation Sun Sparcstation 330 (Unix) - XView graphics support.

2. What type of operating system is required?

Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes "C" compiler is required only for source code modifications. CLIPS is used to build data objects.

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

2000 - 5000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

32000kb +

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Difficult

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.
Moderate

9. What would be the approximate cost to NASA to acquire this tool?
0 - \$1000 per copy

10. What is the approximate annual cost of user support?
1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?
0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.
Ease of flow data entry, Quick turnarounds for analysis, GUI promotes user friendly attributes, Amenable to Quick "What If" work.

13. Can you envision this tool being applied during a "space system" development?
Yes

14. If you can envision such a usage, how?
See ESDOTS documentation

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?
Yes

Overall Assessment

38

Expert System for Design, Operations, Technology Studies (ESDOTS). - Unix workstation based tool for the analysis of launch system ground operations. Because of workstation nature and tailored to launch system programs this tool probably not be part of a RM&S toolbox but the toolbox outputs could provide inputs into ESDOTS. Follow-up suggested.

1066 SLAM II

1. In the context of this survey the term "tool" is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model, A Simulation

2. What is the name of this tool? SLAM II

3. Is it identified by other names? Yes

If yes, please specify:

Simulation Language for Alternative Modeling.

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Alan Pritsker of Pritsker Corp.

5. When was this tool developed or first used?

1987

6. What is the purpose of this tool?

Allows operability engineers to code various operations discrete event, continuous, or network simulation models to simulate real system operations dynamics and processes which cannot be modeled using a deterministic method.

7. What elements of RM&S/Operability does this tool cover?

You can model queues, resource contention, and any event or events that have complex or simple inter dependencies.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation,
Production, Operations, Modification

10. Who owns (or controls) this tool?

Pritsker Associates

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? They must license the workstation version of SLAM II on a yearly basis.

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Hundreds of models written by commercial manufacturers using SLAM II. Result we generate have been validated against contractor models developed using totally different software (L-Systems).

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Resiliency modeling, launch rate studies of KSC & Space Station Logistics Studies.

16. Who if anyone provides user support or upgrades for this tool?

Pritsker & Associates via Hotline.

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

A operations concept and understanding of what is being modeled and what results are to be gathered (i.e. long lead items).

Resources Questions:

1. What type of computer is required for this tool?

Workstation, Personal

2. What type of operating system is required?

Unix, Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes MS FORTRAN Powerstation for PC Windows version., FORTRAN for Unix Workstation

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

40000kb +

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

32000kb +

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Difficult

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required Extensive mathematics or statistics background required, Design Engineer background required, General college or academic background required Other at least 1 year experience coding SLAM II models.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Difficult

9. What would be the approximate cost to NASA to acquire this tool?

10000 - \$50000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

30+ days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

The tool although hard to learn, is very versatile. It has many built in capabilities not found in cheaper simulation packages.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

Can be used to do parametric reliability studies as well as operations flow modeling.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

29

Simulation Language for Alternative Modeling. (SLAM II) is a workstation or PC based modeling and simulation software package. This robust package has obvious application in the RM&S/O area even in the early concept exploration phases of a program. Its costs and training requirement may make this tool less desirable if an easier simulation tool can be found.

SPARTA 36

Address Information:

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Organization Type: Industry

Tool ID	Tool Name
1067	LOGSIM
1068	LOGAM
1069	TOPSAM
1071	Sparta Inc. GBI Cost Model

General Comments

What is your definition of system operability?

The condition at which all elements required for the system to meet all of its functional goals are available.

Would you like to receive the results of this survey? Yes

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Performing supportability assessment early in its development cycle will point out any needed enhancements when changes can be made at low cost.

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Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1067 LOGSIM

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Simulation

2. What is the name of this tool? LOGSIM

3. Is it identified by other names? Yes

If yes, please specify:

Logistics Simulation Model

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Teledyne Brown Engineering, SRS Technologies and SPARTA for USASSDC

5. When was this tool developed or first used?

1982

6. What is the purpose of this tool?

To model the support system (logistics) of a deployed defensive system by using discrete event simulation.

7. What elements of RM&S/Operability does this tool cover?

As a simulation, this tool models and assesses the effectiveness of a support system in achieving an operational availability goal for the system it is supporting. The required support tools and manpower are also developed, as well as the operational support costs.

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

LOGAM Desktop

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9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept

10. Who owns (or controls) this tool?

USASSDC, Jim Pierce 955-1831

11. Is it available for others to use?

Yes With government approval.

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? With USASSDC approval only

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. In August 1992 a confidence assessment of this model was made by the Analytic Toolbox (ATB) group representing BMDO.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? The LOGSIM simulation provides a great number of statistical results for determining support system effectiveness.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

National Missile Defense (NMD) and Theater High Altitude Area Defense (THAAD)

16. Who if anyone provides user support or upgrades for this tool?

USASSDC

17. Does a database exist to support this tool? Please describe.

Yes

A sample database is delivered with the model. The user provides other input.

18. What specific data must be collected or available for operating this tool?_

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Failure rates, repair rates for the systems being modeled, deployment specifics for the systems being modeled, logistics factors (pipeline delays).

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

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10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

For Ground Support Elements.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

49

Logistics Simulation Model (Logsim) (U.S. Army Missile Defense) - This tool models a deployed defensive system to compute operational availability. Since it is targeted for Pre-Concept phase, it could be very useful for the NASA tool set. It is written primarily for defense systems, and it is a Monte Carlo simulation, which may make Logsim difficult to integrate into a tool set.

1068 LOGAM

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? LOGAM

3. Is it identified by other names? Yes

If yes, please specify:

Logistics Analysis Model

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

US Army MICOM

5. When was this tool developed or first used?

1973

6. What is the purpose of this tool?

To analyze logistics concepts and measure the operational availability obtained for a supported system.

7. What elements of RM&S/Operability does this tool cover?

Availability and operational support cost.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept

10. Who owns (or controls) this tool?

USASSDC, Jim Pierce 955-1831

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? With government approval only

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. A technical requirements analysis was performed by LOGSA (the Army's Logistics Support Agency) in June 1995.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool? This tool provides sensitivity analysis capability for analyzing the effect of single parameters or operational availability and cost. Key elements can be identified for modification.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

National Missile Defense (NMD), Theater High Altitude Area Defense (THAAD), Patriot, Pershing

16. Who if anyone provides user support or upgrades for this tool?

USASSDC

17. Does a database exist to support this tool? Please describe.

Yes

A sample database is delivered with the model. The user provides other input.

18. What specific data must be collected or available for operating this tool?

Failure rates, repair rates for the systems being modeled, deployment specifics for the systems being modeled, logistics factors (pipeline delays) and investment costs.

Resources Questions:

SPARTA 36

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Logistician background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

For Ground Support Elements.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

47

LOGAM (Logistics Analysis Model) Desktop (U.S. Army Missile Defense) - This tool models a deployed supported system to compute operational availability and operation and support cost. This could be useful for the tool set, and it is not a Monte Carlo simulation. This tool is a 1970s DOS program, and a user interface may be needed to integrate this into the tool set..

1069 TOPSAM

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? TOPSAM

3. Is it identified by other names? Yes

If yes, please specify:

Total Operating and Support Analysis Model.

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

US Army CECOM for the Pershing Project Office

5. When was this tool developed or first used?

1983

6. What is the purpose of this tool?

Develop tables of organization and equipment (TOE) for the operation and support of a system. Determine the cost to operate and support / determine the manpower and support equipment for supporting a system.

7. What elements of RM&S/Operability does this tool cover?

Operational availability and operations and support cost.

8. If this tool is not a model, does it support a model?

N/A If so what is the name of that model?

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept

SPARTA 36

10. Who owns (or controls) this tool?

USASSDC, Jim Pierce 955-1831

11. Is it available for others to use?

N/A

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? With government approval only

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Listed in AMC PAM 700-4. Approved by TRADOC

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?
Provides a quick turnaround tool to determine changes in Manpower requirements when system architecture and/or design changes.

15. Please list examples of programs, projects, systems or products that this tool has been used on.
National Missile Defense (NMD), Theater High Altitude Area Defense (THAAD), Pershing

16. Who if anyone provides user support or upgrades for this tool?

USASSDC

17. Does a database exist to support this tool? Please describe.

Yes

A sample database is delivered with the model.

18. What specific data must be collected or available for operating this tool?

Access to government databases such as the MPRC (Manpower Analysis Requirements Criteria) and SB 700-20.

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

641 - 1000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Design Engineer background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

SPARTA 36

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Effective in linking current databases related to supportability by providing manpower "assessment".

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

To determine manpower requirements to operate and maintain systems.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

60

TOPSAM (Total Operating and Support Analysis Model) (U.S. Army Missile Defense) - This tool actually develops the Support Equipment and Manpower necessary to maintain a deployed system, and computes the support costs. Since it is targeted for Pre-Concept, it may very well be valuable as a tool set candidate. As a Windows tool, it should integrate easily.

1071 Sparta Inc. GBI Cost Model

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other A Cost Model

2. What is the name of this tool? Sparta Inc. GBI Cost Model

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Alfred R. Johnson (consultant to Sparta)

5. When was this tool developed or first used?
1985

6. What is the purpose of this tool?
To support all GBI cost exercises.

7. What elements of RM&S/Operability does this tool cover?
Operations & Support

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operations, Modification, Disposal

10. Who owns (or controls) this tool?

Government (GBI Project Office)

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? No If yes, please describe the method and results.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

GBI and eventually JTUAV

16. Who if anyone provides user support or upgrades for this tool?

Alfred R. Johnson

17. Does a database exist to support this tool? Please describe.

No

18. What specific data must be collected or available for operating this tool?

All data associated with the cost estimating process

Resources Questions:

1. What type of computer is required for this tool?

Personal

2. What type of operating system is required?

Windows

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

5001 - 10000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required. This model is written in Lotus 1-2-3 for Windows must have above average spread sheet knowledge.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

1001 - \$5000 per copy

10. What is the approximate annual cost of user support?

1001 - \$5000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Capable of quick turn - around cost estimates time - phase constant and real dollars, monthly delivery schedules, capable lead / lag cost

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

There is a skeleton of this model that can be used for space systems

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

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Smart Inc. GBI Cost Model (U.S. Army Missile Defense) - This is a spreadsheet application for performing Operating and Support Cost estimates. It must be a compiled application because the spreadsheet software (Lotus 123) is not required with it. The user must be used to spreadsheets, however, and this may limit its desirability for toolbox inclusion.

Program Executive Office, Missile Defense 37

Address Information:

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E-Mail Address: brewer-md-hsv@redstone.army.mil

Organization Type: Government

Tool ID	Tool Name
1070	ACEIT

General Comments

No operability or summary answers provided.

What is your definition of system operability?

Would you like to receive the results of this survey?

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1070 ACEIT

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

Other A Cost Model

2. What is the name of this tool? ACEIT

3. Is it identified by other names? Yes

If yes, please specify:

Automated Cost Estimating Integrated Tools

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Tecolote Research Inc.

5. When was this tool developed or first used?

1992

6. What is the purpose of this tool?

Develop cost estimates for various Army weapon programs.

7. What elements of RM&S/Operability does this tool cover?

Operations & Support Phase

**8. If this tool is not a model, does it support a model? No
If so what is the name of that model?**

9. In which phase of the acquisition life-cycle is this tool the most useful?

Pre-Concept, Concept Exploration, Demonstration/Validation, Full Scale Development, Production, Operations, Modification, Disposal

10. Who owns (or controls) this tool?

Tecolote Research Inc.

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Contractors have to go through the government to get access. Take the training course (highly recommended for first time users).

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. It is the official Army cost model program.

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Ground Based Interceptor, THAAD, Patriot PAC 3

16. Who if anyone provides user support or upgrades for this tool?

Tecolote Research Inc.

17. Does a database exist to support this tool? Please describe.

Yes

There is a library of non commercial & commercial cost models built into ACEIT.

18. What specific data must be collected or available for operating this tool?

Program Schedule, Quantity.

Resources Questions:

1. What type of computer is required for this tool?

Personal, PC 386 or 486 (with math coprocessor recommended) 15 to 23 MB Hard Disk Space, DOS 3.3 or higher, 2.5 MB RAM or higher, monitor with graphics

2. What type of operating system is required?

Other DOS

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

None

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

10000 - 40000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

2001 - 4000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required. It would help to have cost analysis background.

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

ACEIT is an estimating system containing a variety of tool such as ACE, COSTAT (a full fledged statistics package) Cost Estimating models and RISK (a model which quantifies risk associated with a cost estimate)

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

This model is designed to support any type of government weapon program. It does have limitations like any other cost model, but as a user I recommend it.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

49

Automated Cost Estimating Integrated Tool (ACEIT) (U.S. Army Missile Defense) - This is the official U.S. Army costing model, and the accompanying training is highly recommended. This training requirement may make this tool less desirable if an easier costing tool can be found or developed. This is a very large DOS based non-simulation tool.

Sigmatech, Inc. 38

Address Information:

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Organization Type: Industry

Tool ID	Tool Name
1072	Hardware vs. Manpower Analysis
1073	All Source Analysis Sustainment Model (ASM)
1074	RAM Code (Reliability, Availability, Maintainability)
1075	KAPP II
1076	KSC GO Methodology and Code
1077	Logistics Analysis Model (LOGAM II)
1078	Maintenance Prediction Software

General Comments

Note: No operability definition or summary questions answers provided.

What is your definition of system operability?

Would you like to receive the results of this survey?

Any comments or suggestions you may have for improving the ability to assess the overall operability of a system early in it's development cycle.

Sigmatech, Inc. 38

Are there any specific contacts you recommend NASA should make to enhance the value of this survey? Please specify.

Did we ask the right questions? If not, please suggest how we might improve this survey.

1075 KAPP II

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Methodology

2. What is the name of this tool? KAPP II

3. Is it identified by other names? Yes

If yes, please specify:

KAPP, KNAPP, Kinetic Energy Effects Program II

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Defense Nuclear Agency

5. When was this tool developed or first used?

1990

6. What is the purpose of this tool?

Projectile effects and target response. Hypervelocity impact chunky and long rod projectiles. Complex targets and structural response. Modular tool for developing new algorithms.

7. What elements of RM&S/Operability does this tool cover?

Reliability

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

BRL-CAD, EAST GEN, GIFT

9. In which phase of the acquisition life-cycle is this tool the most useful?

Concept Exploration

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10. Who owns (or controls) this tool?

Defense Nuclear Agency

11. Is it available for others to use?

Yes

12. Are there any restrictions or constraints on others using this tool? Yes If so what are they? Export-controlled

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. It has been compared to large body of experimental data. Algorithms accredited by U.S. Army

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

Comparison to experimental and numerical results.

15. Please list examples of programs, projects, systems or products that this tool has been used on.

PATRIOT, ERINT, THAAD, BPI, ABI

16. Who if anyone provides user support or upgrades for this tool?

Kaman Sciences Corporation Rodger Greer (greer-cos1@kaman.com)
(718) 599-1600

17. Does a database exist to support this tool? Please describe.

Yes

A large calibration database of experimental data was assembled.

18. What specific data must be collected or available for operating this tool?

Target and projectile specifications including geometry, materials, and critical components.

Resources Questions:

1. What type of computer is required for this tool?

Personal, Workstation

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2. What type of operating system is required?

Windows, McIntosh, Unix

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

Yes FORTRAN optional

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

1001 - 2000kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

1001 - 2000kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Easy

9. What would be the approximate cost to NASA to acquire this tool?

0 - \$1000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

0 - 14 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

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The code is designed to analyze complex geometrical objects using an efficient, user-friendly system of keywords. Inputs and outputs are via ASCII files. Providing machine independence. Key variables may be easily extracted for post-processing.

13. Can you envision this tool being applied during a “space system” development?

Yes

14. If you can envision such a usage, how?

Could be used for analysis of a wide range of penetration hazards. Also models effects such as explosive and hydraulic RAM.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

57

KAPP II (Sigmatech, Inc.) - This is a methodology to analyze projectile effects. It does not seem to have applicability for the RMS/O tool set

1078 Maintenance Prediction Software

1. In the context of this survey the term “tool” is being used to mean any method that helps meet RM&S/Operability objectives in the overall system development process. The data provided herein best describes the following (please check the most appropriate box).

A Model

2. What is the name of this tool? Maintenance Prediction Software

3. Is it identified by other names? No

If yes, please specify:

4. Who developed or initiated this tool? (Agency, organization, company, individual, etc.)

Teledyne Brown Engineering, Space Programs SRM Group

5. When was this tool developed or first used?

1991

6. What is the purpose of this tool?

To provide inputs to the detailed design approach, and to the detailed maintenance and support plan based on maintenance predictions. Provide maintenance results. The tool allows determination whether maintenance requirements will be achieved with the design and the described support personnel/skill requirements.

7. What elements of RM&S/Operability does this tool cover?

Maintenance

8. If this tool is not a model, does it support a model?

Yes If so what is the name of that model?

MIL-HDBK-472 Proc T1

Sigmatech, Inc. 38

9. In which phase of the acquisition life-cycle is this tool the most useful?

Demonstration/Validation, Full Scale Development, Operations, Modification

10. Who owns (or controls) this tool?

Teledyne Brown Engineering

11. Is it available for others to use?

No

12. Are there any restrictions or constraints on others using this tool? No If so what are they?

13. Has this tool been validated or verified in any manner? Yes If yes, please describe the method and results. Calculations have been verified manually

14. What metrics do you use or would recommend for determining the value and effectiveness of this tool?

15. Please list examples of programs, projects, systems or products that this tool has been used on.

Space Station flight hardware

16. Who if anyone provides user support or upgrades for this tool?

No one

17. Does a database exist to support this tool? Please describe.

Yes

NPRD-95, MIL-HDBK-217F

18. What specific data must be collected or available for operating this tool?

Failure rates, shut down, sorting times; remove, replace, and checkout times.

Resources Questions:

1. What type of computer is required for this tool?

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Personal

2. What type of operating system is required?

McIntosh

3. Are any compilers (eg. FORTRAN, SIMSCRIPT, PROLOG) or additional software (eg. Lotus, MathCad, Dbase) required for this tool? Please specify.

No

4. Please indicate the amount of mass storage required to store the files necessary for this tool.

0 - 500kb

5. Please indicate the amount of random access memory (RAM) required to execute this tool.

0 - 640kb

6. Please check the box which reflects the ease of moving this tool from one machine of the specified computer type to another; that is, the ease of installation and de-installation.

Very Easy

7. Please check the box which reflects the educational or professional background necessary for use of this tool.

Reliability or Maintainability background required, Logistician background required, General college or academic background required

8. Please check the box which reflects the ease of becoming an effective user, given the above background.

Moderate

9. What would be the approximate cost to NASA to acquire this tool?

1001 - \$5000 per copy

10. What is the approximate annual cost of user support?

0 - \$1000 per copy

11. What is the approximate delivery time for this tool once requested by NASA?

Sigmatech, Inc. 38

14 - 30 days

12. Please provide a brief assessment of the effectiveness and benefits of using this tool based on your experience.

Once data has been entered the software can provide IVA corrective maintenance prediction, worksheets, IVA preventive maintenance worksheets, EVA corrective and preventive maintenance worksheets, IVA MMH/Year summary sheet, EVA MMH/Y summary sheet. Also each worksheet has MMH/Y calcs, maintenance procedures, checkout plans, fault detection steps, shut down safeing steps.

13. Can you envision this tool being applied during a "space system" development?

Yes

14. If you can envision such a usage, how?

It has been used for Space Station flight hardware.

15. Can the information which you have given in this questionnaire be released to the public with your consent, or should it be considered proprietary?

Yes

Overall Assessment

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Maintenance Prediction Software - This is a Mac tool for performing Maintainability Timeline Analysis. It is most applicable in Dem/Val and beyond. The tool has already been used to analyze Space station Flight hardware. It is worth further investigation.